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A National Environmental/Energy Workforce Assessment. Post-Secondary Education Profile Potable Water I (Single Degree Programs)

National Field Research Center, Iowa City, IA

Prepared for

Environmental Protection Agency, Washington, DC

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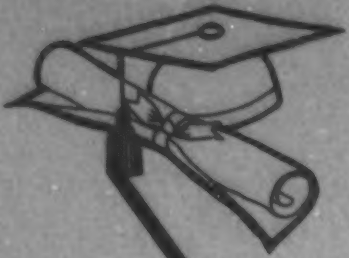

Post Secondary Education Profile

POTABLE WATER I

(Single Degree Programs)

Phase II

Of A National Environmental/Energy Workforce Assessment

Conducted by:

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16. ABSTRACT

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs — their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates.

Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

Phase I of the study assessed the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Phase III, which will be available in September 1979, will offer recommendations, curriculum changes, and modifications that appear necessary to assure a properly trained national environmental workforce

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NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

POTABLE WATER

VOLUME I

(Single Degree Programs)

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC.

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

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INTRODUCTORY NOTE

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TABLE OF CONTENTS

Page

TABLES iv

ACKNOWLEDGEMENT v

REVIEW COMMITTEE vi

FOREWORD viii

POTABLE WATER SUMMARY ix

PROJECT BACKGROUND 1

INTRODUCTION 9

PROJECT FINDINGS 43

I. A SUMMARY PROFILE OF REPRESENTATIVE POTABLE WATER EDUCATIONAL PROGRAMS

- A. States, Institutions, Programs and Degrees 45
- B. Enrollment Statistics and Graduates 46
- C. Student Origin 47
- D. Employment 48
- E. Faculty 50
- F. Internship/Applied Study Terms 51
- G. Graduate Follow-Up 51

II. ADDITIONAL FINDINGS

- A. Recruitment Techniques 52
- B. Research Funding and Sources of Student Support. . 53
- C. Usage of ERIC and IRIS 54
- D. Curriculum Flexibility 56
- E. Environmental Occupations 59

III. TABLE 8 - A SUMMARY PROFILE OF REPRESENTATIVE POTABLE WATER EDUCATIONAL PROGRAMS 63

PROJECT COMMENTARY 75

LIST OF POTABLE WATER INSTITUTIONS BY DEGREE 83

POTABLE WATER TRAINING SUMMARIES 87

APPENDICES 289

I. DEGREE ABBREVIATIONS I-1

II. TERMINOLOGY II-1

III. SELECTED BIBLIOGRAPHY III-1

IV. PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY . IV-1

V. COLLEGE CATALOGS REVIEWED V-1

DOCUMENT COMPLETE - PAGINATION PER SOURCE

TABLES

Table	Title	Page
1.	Participating Institutions.	13
2.	Potable Water Enrollment Profile Summary.	47
3.	Potable Water Employment Summary.	49
4.	ERIC/IRIS Utilization Profile - Potable Water	55
5.	ERIC/IRIS Utilization Profile - National Summary. . .	56
6.	Time Required to Implement a Complete Content Change in a Course	56
7.	Time Required to Implement a Complete Program Sequence	58
8.	A Summary Profile of Representative Potable Water Educational Programs.	63

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REVIEW COMMITTEE

A special word of acknowledgement is extended to the following people who graciously gave of their time, knowledge and experience in order to review and comment on the information included in this volume. The efforts of this national committee were particularly insightful, and in general have been incorporated into the final report.

It must be pointed out that in all cases the individuals acknowledged below were asked only to review and comment on the material contained in the volume and to express their views regarding the representativeness of the material presented. They were not asked to endorse either the volume or the study in general, and the inclusion of their name on this list should not be considered an endorsement since such was not the intent.

In light of numerous responsibilities, it is especially important to note that these persons responded within very strict time constraints. Such a pattern reflects positively on both the individuals and the institutions and organizations which they represent.

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FOREWORD

Information for this report was largely compiled from on-site interviews with professionals in post-secondary institutions throughout the United States. On-site interviews were supplemented by telephone and/or mail contact to clarify and revalidate the data. This report presents a summary of programs in junior colleges, vocational/technical training institutes, community colleges, four-year colleges, and universities as well as other training institutions. Programs are representative of all levels from academic certification through doctoral degrees. The environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater and energy were surveyed.

This study was conducted for the United States Environmental Protection Agency by the National Field Research Center, Inc. of Iowa City, Iowa, with field offices located in Atlanta, Georgia; Denver, Colorado; and Washington, D.C.

NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

POTABLE WATER
SUMMARY

THE FOLLOWING PAGES PRESENT AN OVERVIEW, IN SUMMARY FORM, OF BOTH VOLUMES OF THE POTABLE WATER REPORT. WHILE THE SUMMARY SYNOPSIZES THIS ENVIRONMENTAL AREA, INTERESTED READERS ARE ENCOURAGED TO REFER TO BOTH POTABLE WATER VOLUME I AND POTABLE WATER VOLUME II FOR A MORE IN-DEPTH PRESENTATION OF THE PROGRAMS.

POTABLE WATER

A. States, Institutions, Programs and Degrees

Potable Water Volume I and Potable Water Volume II include 101 postsecondary programs from 33 states. In all, 77 institutions are represented in these volumes. The programs vary in size and in description from operator training at the local level to advanced degree programs offered within the universities. Degrees offered by the institutions, and presented in the two volumes in the program summaries, are represented as follows:

POTABLE WATER PROGRAM DEGREE OFFERINGS

Program Degree Offerings	Percent Represented In Potable Water Volumes
Certificate	5%
Diploma	2%
Associate Degree	14%
Certificate, Diploma and Associate Degree*	4%
Associate and Bachelors Degrees*	4%
Bachelors Degrees	5%
Masters Degrees	17%
Bachelors and Masters Degrees*	9%
Bachelors, Masters and Doctoral Degrees*	12%
Environmental Engineer Degree	1%
Masters and Doctoral Degrees*	27%

* Multiple degree programs

Due to the extensive number of program summaries, the report on potable water postsecondary programs was presented in two volumes. The Potable Water Volume I contains all single degree programs, the majority of which are associate degree and masters degree programs. These two program levels comprise 66% of the Volume I summaries.

The multiple degree programs are presented in Potable Water Volume II. The preponderance of these multiple degree programs include bachelors, masters and doctoral degrees, and masters and doctoral degrees programs. In Volume II these two types of multiple degree offering programs comprise 73% of the summaries.

B. Enrollment Statistics and Graduates

Program recruiting techniques are as numerous as the programs themselves. The most widespread form of recruitment is by means of distribution of brochures or posters with tear-off cards. Programs at all levels, find this to be a most effective method of advertising. The majority of program personnel interviewed report excellent student response to these methods.

In addition to brochures and posters, community colleges and technical schools actively solicit students through career orientation day programs, high school visitations, mass mailings to area high school teachers and even newspaper ads. These techniques seem to be most effective. Results indicate that over 30% of the students enroll as a direct result of active recruitment. Personnel employed in the field are also actively recruited for certification programs and upgrading seminars, through brochures sent to state associations and other employment sites as well as direct mailing to operators.

Undergraduate recruitment closely parallels that of community colleges. Admission offices often send representatives to high schools and community colleges to recruit students for the institution rather than for a particular program. Within the institution, students are recruited for specific programs.

A majority of contact persons, associated with engineering programs, expressed concern with the difficulty in attracting well qualified undergraduate students to masters and doctoral programs because of the high salaries offered by the private sector to the baccalaureate graduates.

Potable Water Volume I includes 42 programs in which the student origin predominately (87%) is characterized as in-state. Approximately 22% of the programs report 100% of the students as originating from within the state. It is noted that 6% of the programs did not report the student origin. Of the 23 states represented in Potable Water Volume I, five reported foreign students. These states have identified, within the represented programs, foreign student enrollments of from 10% to 20%.

In-state student origin also is predominately reported in Potable Water Volume II. Of the degrees offered, 65% identify at least 50% of the students as originating from in-state, with 2% reporting 100% from within the state. Out-of-state students in excess of 50% are reflected by 28% of the degree offerings. Of the 28 states represented in Volume II, 14 report the presence of foreign students, ranging from 5% to 33%.

The majority (55%) of the programs included in the two potable water volumes, enroll from three to 20 full-time students, although full-time enrollment includes as few as one and many as 530. No part-time students are reported by the majority of the programs included in the two volumes (56%), although as few as one and as many as 500 part-time students were identified.

The table below presents the enrollment profile summary for both potable water volumes. The majority of the full-time students presented in these volumes are enrolled in associate, certificate and bachelors level programs. The preponderance of part-time students are enrolled in certificate and masters degree programs.

POTABLE WATER ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-Time	Enrollment Part-Time	Average # Per Year	Graduate Enrollment Change By Program Up	Down	Stable
Certificate	212	1,041	108	1	0	3
Diploma	110	0	55	0	0	2
Associate[1]	347	39	26	9	1	3
Bachelors[2]	217	4	24	2	0	3
Masters	154	283	19	5	2	6
Env. Eng.	3	0	2	0	0	1
Doctoral[3]	0	0	0	0	0	0
TOTAL	1,043	1,367	234	17	3	18

[1] Does not include Miami-Dade Community College for which figures were unavailable.

[2] Does not include University of Rhode Island and Illinois Institute of Technology for which figures were unavailable.

[3] Does not include Rutgers University, Renssalear Polytechnic Institute, and University of Rhode Island for which figures were unavailable.

Graduates per year range from zero (3% of the programs) to 185. Approximately 52% of the programs are characterized by from one to ten graduates per annum, while 22% reported from 11 to 20 graduates annually.

Approximately 13% of programs reported in excess of 21 graduates per annum, while information was not available for 10%.

A review of the table entitled "Potable Water Enrollment Profile Summary" shows that 47% of the programs presented in the potable water volumes are characterized by program personnel, as stable regarding graduates and enrollments. A slight downward trend is indicated in 8% of the programs, while 45% reported increasing student enrollment and number of graduates. The programs reporting significant increases are at the associate degree level. The masters programs also indicate slight growth and expansion. In part, this may be due to the national trend which is characterized by increasing numbers of adults returning to postsecondary institutions for further academic and/or skill training.

Graduate placement and follow-up were a major area of interest on the part of the project staff. Few program personnel were able to provide data other than entry level information regarding graduates. Alumni associations, annual departmental mail surveys, personnel offices and personal contacts were the most numerous means employed to place graduates and to track post-graduation employment. Overall, 70% of the programs utilize some form of graduate follow-up. The remaining 29% do not have a follow-up procedure and 1% of the programs were unable to supply the information

C. Faculty

The faculty represented in the potable water volumes totals 1,082 persons. Of the total, 802 or 74% are reported as full-time, and 280 or 26% are reported as part-time. No attempt was made to develop a faculty-student ratio. A ratio of this nature was deemed less than meaningful for several reasons which include the fact that some faculty are engaged primarily in research or in adminsitration. In addition, some faculty were not cost-centered through the department and/or some were responsible for an overload (additional courses).

Most of the faculty members interviewed belong to professional organizations and are involved in research activities. Several persons were represented on national boards and task forces, and are well known contributors in the areas of pollution control and abatement.

D. Curricula

Programs that address the educational needs of students at the certificate/associate degree level, are structured in similar fashion. Chemistry, biology and microbiology, along with fundamental instruction in water treatment plant operations, compose the core of the majority of programs described in the potable water volumes. Although requirements and electives vary with each program, the majority (58%) at this level, require an internship which usually involves work in a treatment plant.

The preponderance of the baccalaurate programs presented in the two volumes are included in civil or environmental engineering departments. Course work includes strong emphasis on the physical and natural sciences. Core requirements usually include courses in design, operation and maintenance of water treatment plants, water (and wastewater) analyses, environmental health, and applicable environmental engineering.

Graduate level curricula complements the undergraduate programs. Graduate students acquire a more in-depth understanding of design and operation of water treatment and supply facilities through rigorous course work and research. Time constraints imposed upon an educational institution in order to add a new course or implement a new program vary depending upon the nature of the program. If additional faculty, funding or equipment are needed, five years may elapse prior to approval. However, the majority of programs are able to implement a program change within one year, while replacements are usually implemented within one semester. State universities, for the most part, have limitations on number of faculty and students and, therefore, must replace rather than add programs. Community colleges and technical schools, often, must develop curricula before offering new programs. In such cases, program approval may take up to two years.

While the majority of schools can add a program within one year, and a course within a semester, it may take three years for the changes to appear in the catalogue. New programs and courses are often quite innovative and experimental and, demonstration of need and success may be prerequisite to official status. A new program which is an outgrowth of an existing program with expanded scope, is usually approved more easily, because the need and the faculty have been established.

E. Research Funding and Sources of Student Support

Research funding and student support play a vital role in the quality of education at the majority of institutions visited. Research money comes from a variety of sources, both public and private. Federal agencies such as the U. S. Environmental Protection Agency, National Science Foundation, National Institute of Health and the Army Corps of Engineers, support a substantial amount of research at most of the major universities. State and municipal agencies also contribute a significant amount of money for research activities at local institutions. Private industry research grants and private consulting contracts generate the majority of funding from the private sector.

Community colleges and technical schools traditionally receive very little research funding because they are training rather than research oriented. Occassionally EPA, a state or local agency will allocate funds for upgrading existing programs, community education, or further training for employed treatment plant operators.

The majority of research grants and contracts are directed toward graduate level research and often support both faculty and graduate students. Student support is often dependent upon the number of acquired research grants. The majority of graduate students receive financial assistance in the form of research assistantships, teaching assistantships or graduate fellowships. Clearly, the number and the amount of EPA training grants is declining. This decline often severely impacts post-secondary programs.

Undergraduate students in need of financial assistance often receive general financial aid packages which may take the form of university grants, basic educational opportunity grants, loans, and college work-study. A majority of the students (reflected in the water volumes) receive financial aid at private institutions, while undergraduate students at state supported universities are meeting their financial responsibilities without outside assistance.

F. Employment

The following table illustrates the employment profiels in summary, for the two potable water volumes, and includes the students presented in these volumes. While students graduating from certificate and associate degree level programs predominantly enter public sector employment, the graduates of bachelors, masters and doctoral degree programs enter the pirvate sector. The reason, reported by the major number of program personnel, was salary level. Although the federal wage scales are more in line with the private sector, historically, state and local governments are not always able to meet this economic challenge.

POTABLE WATER EMPLOYMENT PROFILE SUMMARY

Degree	Private Sector Industry/	Consulting	Total	Government	Other
Certificate	38%	1%	39%	61%	-
Diploma	59%	21%	80%	18%	2%
Associate	31%	4%	35%	65%	-
Bachelors[1]	36%	29%	65%	32%	3%
Masters[1]	31%	28%	59%	37%	4%
Env. Eng.	8%	41%	49%	33%	18%
Doctoral[1]	22%	39%	61%	29%	10%

[1] Does not include Illinois Institute of Technology for which figures were unavailable.

At present, the student follow-up network does not readily provide for the categorization of the institution's graduates into distinct vocational roles. Although specific entry level pos-tions are often known, most knstitutions limit their graduate occupational profiles to "government", "industry", and "consulting". The following listings, however, are the result of program personnel selections of 28 water and wastewater related occupations. Of the programs represented in the volumes at the certificate, diploma or Associate level, the majority of graduates are trained for the following occupations:

- Engineering Aide
- Industrial Waste Inspector
- Superintendent - Water & Sewer Systems
- Water Treatment Plant Operator

A Bachelors program, in most cases, graduates students prepared to enter the above and, in addition, the following occupations:

- Environmental Engineer
- Sanitary Engineer
- Chemist
- Aquatic Biologist

At the graduate level, most students find employment with private consulting firms or governmental agencies as Environmental Engineers. In addition, students enter the following occupations:

- Water Resource Engineer
- Superintent/Supervisor - Waterworks
- Health Physicist

Graduates of doctoral programs often enter university positions. Summarizing the occupations, graduates of less than four year institutions usually find employment with a municipal or private water/wastewater treatment plant as operators. It is through promotion and continuing education that these people advance to higher level positions. Graduates of these programs have little difficulty in finding employment.

Students with bachelors degrees often return to school ofr a masters degree after a few years of employment. Those employed with advanced degrees are predominantly products of Environmental or Sanitary Engineering programs. The majority of graduates find employment in their field of study and have a great opportunity for lateral movement.

PROJECT BACKGROUND

Photo reprinted from the University of Wisconsin, Madison Oceanography and Limnology Catalog

PROJECT BACKGROUND

OVERVIEW:

In late 1975, Congress acknowledged the growing national concern for the preservation and conservation of our national resources with a direct inquiry into the availability and readiness of our environmental workforce. That inquiry has taken the form of a three-year, three-phase National Environmental/Energy Workforce Assessment, currently being conducted by National Field Research Center under the direction of the U.S. Environmental Protection Agency. In keeping with the objective of the assessment, this three-phase national effort directs itself at environmental/energy workforce needs, national educational preparedness, and the functional relationship between the two.

PHASE I:

Phase I of the National Environmental/Energy Workforce Assessment focused upon the development of "workforce demand projections" through 1982 for all public environmental agencies. This on-site assessment, which was carried out in all 50 states, Puerto Rico and the Virgin Islands, culminated in a numerical profile of the growth patterns and workforce needs at the national and state levels. Stratification of the overall definition of "environmental occupation" into seven distinct vocational areas enhanced even further the applicability of the results. In addition to this public sector workforce assessment, Phase I included an overview analysis of private sector needs (through an adjunct mail survey of selected businesses and industries) and a brief review of selected environmental educational programs.

Phase I was completed in May, 1977. The 70-volume final report included:

National Abstract	(1)
National Legislation	(1)
Regional Assessments	(10)
State Assessments (including D.C., VI and PR)	(53)
Business and Industry Assessment	(1)
National Summary	(4)

PHASE II:

Phase II of the National Environmental/Energy Workforce Assessment was structured around an intensive on-site inventory of representative environmental educational offerings on a national scale. The primary objective of this project has been to collect and aggregate data on training and educational programs in both the post-secondary education field and in the private sector and to do so by environmental area. Specifically, the study was designed to provide an overview of environmentally related post-secondary education programs, their program structure, representative course offerings, employment history of the graduates, and the faculty structure. Additionally, information was to be collected on program requirements and program projections.

Initially, opportunities to nominate programs for inclusion in this on-site review process was given to the Environmental Protection Agency and its program officers and regional personnel both through the

Project Officer and via direct mail requests; all state departments of education; state environmental agencies and selected media-specific associations. These nominations were supplemented by a direct review of institutional catalogs, information obtained during the first year's on-site activities, and a review of other published sources of information regarding degree programs in environmental areas. These sources are included in Appendix III - Selected Bibliography.

Following their initial development, the lists of nominees were forwarded to the program officers for suggestions regarding additions or deletions. Next, letters were written to those nominated institutions seeking their support and cooperation in the on-site review process. Several programs, some of which were highly recommended, declined the opportunity to participate giving reasons varying from lack of time to the fact that the program being inquired about no longer existed, to outright refusal to cooperate with any government study. These institutions were deleted from the final on-site process. The remainder were included in the study and are shown in Table 1 of each volume. Selection of the sample for the private sector is discussed in depth in that particular volume.

In preparation for the on-site interviews, appropriate persons were contacted in the institution involved and were given a background description of the study, a suggested timetable for the interview process and were told what kind of information was being sought. This was all done in an effort to keep the time involvement of the individual contact persons at a minimum. During the actual on-site interview, generally lasting around one hour, the information was collected, questions asked and answered, and further informational contacts identified. Following this process, each on-site interview was written up in the form of a Training Program Summary, which where time allowed, was returned to the contact person for critiquing prior to inclusion in the report.

Throughout this process, individuals and institutions were given assurance that this study was not an attempt to evaluate program offerings and every attempt has been made on the part of the writers to live up to this assurance. Inclusion in this report provides no assurances of quality, nor should a program's exclusion be consideration of the lack thereof. In many instances certain programs within an institution were not included while others were, primarily due to the determination of the sample - previously discussed. This too should not be viewed in any qualitative manner.

REPORT ORGANIZATION:

The final report, of which this volume is a part, consists of volumes depicting a training profile in each medium under consideration, namely,

Air
Energy
Noise
Pesticides
Potable Water
Radiation
Solid Waste
Wastewater
Composite
Business and Industry and Trade Associations

At the outset it should be pointed out that there are very few degree programs conveying degrees in a particular medium; rather, degrees are offered in various specialties which lend themselves to obtaining employment in one or more of these fields. Nonetheless, to obtain maximum utility for the funding agency, programs were reported in this fashion. The Composite section was necessitated by the number of programs offering course work in multiple fields and differing specializations resulting from course selection. For convenience in handling of the data Potable Water, Wastewater and Composite have been reported in multiple volumes because of the numbers involved. Although separated into volumes either by degree level of the programs involved, as in the case of Potable Water and Wastewater, or by content as in the case of Composite, persons interested in any of these fields would be well advised to review each of the volumes to assure more complete coverage.

Along with the standard introductory pages common to volumes of this nature, each volume contains sections on Project Background, Introduction (consisting of sections devoted to a description of the programs surveyed and covered in the volume), Project Commentary, and the Training Summaries along with the Appendices.

REVIEW PROCESS:

In addition to individual training summary reviews conducted by the persons initially interviewed, each volume has been reviewed internally, by persons in the Environmental Protection Agency and by a select group of review committee members. In the final instance, individuals met during the on-site process were nominated by interviewers for inclusion on the review committee, primarily as a result of their obvious expertise in the field and their evidenced interest in the project.

These persons were then contacted by mail or by telephone in an effort to determine their willingness to serve. The rather stringent timelines necessary to keep the project on course and to deliver the finished product as specified were also detailed. In excess of one hundred persons returned their volumes (out of a mailing of 120) and all but five of these provided usable responses. In these five instances either last minute job demands prevented them from carrying out the review in the short timelines, or (in two instances) individuals indicated that they wanted nothing to do with the process. This particular method of review provided a wealth of valuable information, suggestions for revision of specific elements, and general comments helpful in revising the final documents. In all cases an effort was made to seriously consider and incorporate reviewer suggestions. The persons on the various review committees are individually acknowledged in the front of the volume they reviewed.

Photo reprinted from the University of Missouri, Columbia Bulletin 1977.

INTRODUCTION

Photo reprinted from the Northland College Catalog 1975-76

INTRODUCTION

The quality and the quantity of drinking water is one of the major problems of this decade, as the pressures of expanding population, economic growth and new industrial processes turn us to new sources of raw water and accelerate water re-use. In 1974, Congress passed the Safe Drinking Water Act (PL 93-523). The Act marked the first time that a national commitment was made to safeguard public drinking water supplies.

Primary standards for organic, inorganic and microbiological contaminants and for turbidity in drinking water have been established by the U. S. Environmental Protection Agency pursuant to the Act. Standards have been established by EPA for these classes of contaminents. They are applicable to all public water systems and enforceable by the states which have accepted primary enforcement responsibility or by the EPA. Secondary standards for drinking water (dealing with odor, taste and color) have been proposed. These standards are intended as guidelines only, and are not enforceable by EPA.

In 1976, the EPA set standards for the protection of underground drinking water supplies. EPA estimates that approximately 100 million Americans are dependent upon underground sources of drinking water. To safeguard these increasingly threatened sources from contamination, the standards provide minimum requirements for injecting fluids underground into various types of wells. The standards are enforceable by the states and/or EPA.

Based on the 1969-70 Community Water Supply Study, a field inspection and evaluation of 969 community water supply systems conducted by the million people were being served potentially dangerous water. Additional findings noted that 77% of the plant operators were inadequately trained in microbiology and 46% were deficient in chemistry related to their work.

Education and training are the cornerstones of change necessary to the improvement of our environmental quality. This report is intended to give interested readers a profile of postsecondary potable water educational programs, both public and private. The potable water report describes 101 programs of which 42 are detailed in Potable Water Volume I and 59 in Potable Water Volume II. The report is presented in two volumes due to the extensive number of potable water programs which were identified for inclusion by the project staff. Those programs appearing in the two volumes marked with an asterisk, are also presented in the wastewater volumes due to the often overlapping nature of water and wastewater educational programs.

The Potable Water Volume I includes 42 programs which are described in terms of single degree offerings. Many of the institutions and the programs, however, offer a variety of degrees or certifications, which may not be herewithin presented. The reader is encouraged to refer to Potable Water Volume II for a representation of multiple degree programs.

The following pages present overviews of the programs. Enrollment, student origin and employment are three major areas under consideration. In latter portions of the report, recruitment, research funding and occupations are addressed.

TABLE I

PARTICIPATING INSTITUTIONS

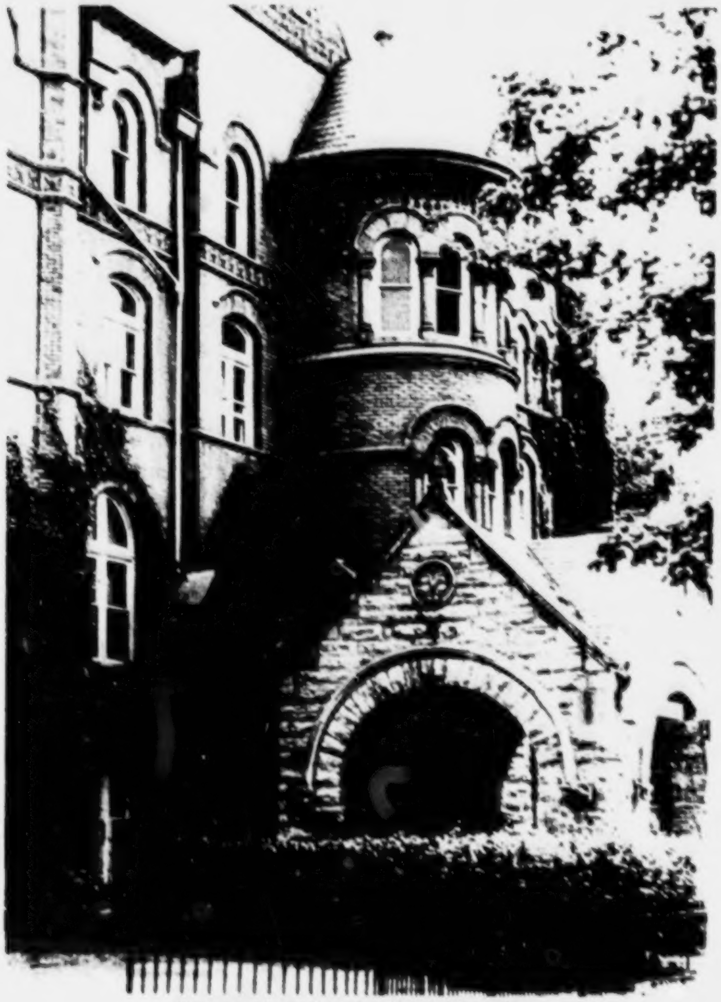

Photo reprinted from the Macalester College
1976-78 Catalog

Table 1 is a comprehensive listing of all institutions which participated in the post-secondary educational profile of the National Environmental/Energy Workforce Assessment. Listed by state, institution, and degree are programs surveyed in the areas of air, energy, noise, pesticides, potable water, radiation, solid waste and wastewater.

An explanation of the degree abbreviations utilized within the report may be found in Appendix I, entitled "Degree Abbreviations". For a complete listing of the institutions visited in a media specific area (i.e., air, energy, etc.), attention is drawn to Appendix IV, entitled "Participating Institutions by Environmental Category".

The Table in part III of the Project Findings, entitled "A Summary Profile of Representative Educational Programs" follows the narrative and is a presentation of specific institutions visited for the particular volume.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)*
AL	University of Alabama University	Environmental Engineering	M.S. (3)
AK	University of Alaska Fairbanks	Environmental Quality Engineering Science	M.S.
AR	University of Arkansas Fayetteville	Agricultural Engineering	B.S. M.S. Ph.D.
		Civil Engineering	M.S.C.E.
		Environmental Engineering	M.S.En.E.
		Environmental Science	B.S.
CA	California Institute of Technology Pasadena	Environmental Engineering Science	M.S. Ph.D.
	California Polytechnic State University San Luis Obispo	Environmental Engineering	B.S.
	California State University-Sacramento Sacramento	Civil and Environmental Engineering	B.S. M.S.
	Stanford University Stanford	Environmental and Water Studies	M.S. Ph.D.
	University of California-Berkeley Berkeley	Nuclear Engineering	B.S. M.S. M.E. Ph.D. D.E.
		Pest Management	B.S.
		Sanitary Engineering	M.S. M.E. Ph.D.
	University of California-Davis Davis	Environmental Toxicology	B.S.
		Plant Protection and Pest Management	M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of California-Davis (Cont'd)	Entomology	B.S. M.S. Ph.D.
	University of California-Riverside Riverside	Pest Management	M.S.
	University of California-Santa Barbara Santa Barbara	Environmental Studies	B.A.
CO	Colorado State University Fort Collins	Environmental Engineering (Civil)	M.S. Ph.D.
	Community College of Denver-Red Rocks Golden	Water-Wastewater Technology	A.A.
CT	Hartford State Technical College Hartford	Nuclear Engineering Technology	A.S.
	Yale University New Haven	Environmental Health	M.P.H.
DE	Delaware Technical and Community College Newark	Environmental Engineering Technology	A.A.S.
	University of Delaware Newark	Entomology and Applied Ecology	B.S.
		Environmental Engineering	M.A.S. M.E. Ph.D.(App. Science) Ph.D.(ChE)
DC	Catholic University Washington	Civil Engineering	B.S.
	Howard University	Environmental Engineering	M.E.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
FL	Broward Community College Fort Lauderdale	Pest Control Technology	A.S.
	Central Florida Community College Ocala	Radiological Health Technology	A.S.
	Florida International University Miami	Environmental Studies	B.A. B.S.
		Environmental Engineering Technology	B.S.
	Heed University Hollywood	Ocean and Environmental Affairs	M.A. Ph.D.
	Miami-Dade Community College Miami	Environmental Engineering Technology	A.S.
		Marine Science Technology	A.S.
	University of Florida Gainesville	Air Pollution	M.E. M.S. Engineer Ph.D.
		Environmental Biology	M.E. M.S. Engineer Ph.D.
		Environmental Resources Management Activities	M.E. M.S. Engineer Ph.D.
		Systems Ecology	M.E. M.S. Engineer Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Florida (Cont'd)	Water Supply and Water Pollution Control	M.E. M.S. Engineer Ph.D.
		Nuclear Engineering	B.S.(N.E.) B.S.E.(N.E.) M.E. M.S. Engineer Ph.D.
		Radiological Sciences	M.E. M.S.
	University of Miami Miami	Marine and Atmospheric Science	M.S. Ph.D.
GA	Abraham Baldwin Agricultural College Tifton	Plant Protection	A.Ag.
	Atlanta University Center/ Georgia Institute of Technology Atlanta	Water Pollution Control Design Engineering	B.S. B.E.
	Georgia Institute of Technology Atlanta	Acoustical Engineering	Advanced Cert.
		Energy Engineering	Advanced Cert.
		Environmental Studies	Advanced Cert.
	Southern Technical Institute Marietta	Nuclear Safety	A.S.
	University of Georgia Athens	Entomology	B.S. A.B. M.S. M.P.P.P.M. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Georgia (Cont'd)	Environmental Health Science	B.S.E.H.
HI	University of Hawaii Honolulu	Environmental and Sanitary Engineering	M.S.
IL	Illinois Institute of Technology Chicago	Environmental Engineering	B.S.E.S. M.S. Ph.D.
	Prairie State Community College Chicago Heights	Air, Water, Wastewater	A.A.S.
	Sangamon State University Springfield	Environments and People	B.A. M.A.
	Southern Illinois University-Edwardsville Edwardsville	Wastewater Treatment Operator Training	Cert.
IN	Indiana University Bloomington	Environmental Programs	Cert. A.S. B.A. B.S. M.P.A. M.S.E.S. Ph.D. (minor)
	Purdue University West Lafayette	Environmental Sciences Option	B.S.
		Nuclear Engineering	B.S.N.E. M.S. Ph.D.
IA	Iowa State University Ames	Environmental Studies	B.A. B.S.
		Sanitary Engineering and Water Resources	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Kirkwood Community College Cedar Rapids	Environmental Health Assistant	Diploma
		Environmental Health Technician	A.A.
		Water and Wastewater	Diploma
	University of Iowa Iowa City	Environmental Engineering	M.S. Ph.D.
		Environmental Toxicology	M.S. Ph.D.
KS	Kansas State University Manhattan	Chemical Engineering	B.S. M.S. Ph.D.
		Mechanical Engineering	B.S. M.S. Ph.D.
		Nuclear Engineering	B.S. M.S. Ph.D.
		Sanitary Engineering	M.S.C.E.
	University of Kansas Lawrence	Environmental Health Engineering	M.S. Ph.D.
		Environmental Health Science	M.S. Ph.D.
		Environmental Studies	B.A.
		Radiation Biophysics	B.A. B.S. M.S. Ph.D.
		Water Resources Engineering and Science	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
KY	Morehead State University Morehead	Environmental Studies	B.S. A.B.
		Mining Technology	A.A.S.
	Pikeville College Pikeville	Mining Technology	A.M.T.
	University of Kentucky Lexington	Energy (Coal) Engineering	M.S. Ph.D.
		Environmental Engineering	M.S. Ph.D.
	University of Louisville Louisville	Environmental Engineering	B.S. M.Eng.
	Western Kentucky University Bowling Green	Environmental Science	B.S.
		Environmental Engineering	B.S.
LA	Delgado College New Orleans	Urban Pest Management	A.S.
		Water/Wastewater Technology	A.S.
		Environmental Health Technology	A.S.
	McNeese State University Lake Charles	Environmental Science	B.S. M.S.
ME	Eastern Maine Vocational Technical Institute Bangor	Environmental Control Technology	A.A.S.
	New England Regional Wastewater Institute (S. Maine Vocational Technical Institute) S. Portland	Wastewater Treatment Technology	Cert.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Maine-Orono Orono	Sanitary Engineering	M.S.C.E. Ph.D.
MD	Charles County Community College La Plata	Pollution Abatement Technology	A.A.
	Johns Hopkins University Baltimore	Environmental Engineering	M.A. M.S.E. M.S. Ph.D
	University of Maryland College Park	Environmental Engineering	M.S.
		Nuclear Engineering	M.S.
		Pest Management	M.S.
MA	Harvard University Cambridge	Environmental Health Sciences	S.M. Sc.D.
		Environmental Sciences and Engineering	S.M. M.E. Ph.D.
		Toxicology	S.M. Sc.D.
	Massachusetts Institute of Technology Cambridge	Acoustics	S.M. Sc.D./ Ph.D.
		Environmental Engineering	Env.E.
		Mineral Resources Engineering and Management	S.M. Engr. Sc.D./ Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Massachusetts Institute of Technology (Cont'd)	Nuclear Engineering	S.B. S.M. N.E. Sc.D./ Ph.D.
		Water Resources and Environmental Engineering	S.B. S.M. Sc.D./ Ph.D.
		Wastewater Treatment Plant Operations	Cert.
	Northeastern University Boston	Environmental Engineering and Science	M.S.
	Springfield Technical Community College Springfield	Environmental Technician	A.S.
	Tufts University Medford	Environmental Health Engineering	B.S.C.E. M.S.
	University of Lowell Lowell	Radiological Health Physics/Radiological Sciences and Protection	B.S. M.S.
		Wastewater Treatment Plant Operations	Cert.
MI	Ferris State College Big Rapids	Environmental Health Technician	A.A.S.
		Environmental Health	B.S.
	Michigan State University East Lansing	Environmental Conservation Education	M.S. Ph.D.
		Environmental Engineering	B.S.C.E. M.S. (emphasis) Ph.D. (emphasis)

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Michigan State University (Cont'd)	Natural Resources and Environmental Education	B.S.
		Systems Science (Ecological Systems)	B.S. M.S. Ph.D.
	Michigan Technological University Houghton	Environmental Engineering	B.S.C.E. B.S.E. M.S.C.E.
	University of Michigan Ann Arbor	Environmental Education	M.S.
		Environmental Sciences Engineering	B.S.
		Industrial Hygiene and Air Pollution	M.P.H. M.S. Dr.P.H. Ph.D.
		Radiological Health	M.P.H. M.S. Dr.P.H. Ph.D.
		Water Resources: Engineering	M.S.E. Ph.D.
		Management Science	M.S. Ph.D.
		Water Quality	M.P.H. M.S. Dr.P.H. Ph.D.
MN	Bemedji State College Bemedji	Environmental Studies	B.S. M.A.
	Macalester College St. Paul	Environmental Studies	B.A. B.S.
	University of Minnesota Minneapolis	Environmental Health	M.P.H. M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
MS	Mississippi State University Mississippi State	Specialized Training in Pest Management	M.Ag.
MO	Missouri Southern State College Joplin	Environmental Health Technology	A.S. B.S.
		Radiologic Technology	A.S.
	St. Louis Community College at Forest Park St. Louis	Radiologic Technology	A.S.
	University of Missouri-Columbia Columbia	Sanitary Engineering	B.S. M.S. Ph.D.
	University of Missouri-Rolla Rolla	Environmental and Sanitary Engineering	M.S. Ph.D.
	Water and Wastewater Technical School Neosho	Water and Wastewater Training	Cert.
	Washington University St. Louis	Air (emphasis)	M.S. D.Sc.
MT	Montana State University Bozeman	Environmental Engineering	M.S.
		Environmental Health Technology	M.S.
	Northern Montana College Havre	Environmental Health Technology	A.A. Cert.
NE	Central Technical Community College Hastings	Agriculture Technology	Cert. 1-Year Diploma 2-Year Diploma A.A.S. A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Nebraska Lincoln	Sanitary Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering	M.S.
		Planning and Management	M.S.
NH	University of New Hampshire Durham	Entomology	B.S. B.A.
NJ	Middlesex County College Edison	Environmental Health Science Technology	A.A.S.
	New Jersey Institute of Technology Newark	Interdisciplinary Studies in Environmental Engineering	M.S.
	Princeton University Princeton	Energy Conversion and Resources	Topical Programs
	Rutgers-SUNJ New Brunswick	Biology (option in entomology)	B.S. B.A.
		Entomology and Economic Zoology	M.S. M.P. Ph.D.
		Environmental and Business Economics	B.S.
		Environmental Science	M.S. Ph.D.
		Environmental Studies	B.S.
		Environmental and Water Resources Engineering	M.S. Ph.D.
		International Environmental Studies	B.A. B.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Rutgers-SUNJ (Cont'd)	Radiation Sciences	M.S. Ph.D.
	Stevens Institute of Technology Hoboken	Air Pollution Control Engineering	Cert.
		Water and Wastewater Engineering	Cert.
NM	New Mexico State University Las Cruces	Pest Management	B.S.
	University of New Mexico Albuquerque	Nuclear Engineering	M.S. Ph.D.
NY	Clarkson College Potsdam	Civil and Environmental Engineering	B.S. M.S.
	Columbia University New York City	Nuclear Engineering	B.S. M.S. Nuc.Engr. Eng.Sc.D.
	Cornell University Ithaca	College Program in Energy Conversion	B.S.
		Environmental Engineering	B.S. M.S. M.Eng. Ph.D.
		Waste Management Engineering	M.S. M.Eng. M.P.S. Ph.D.
		Nuclear Engineering	M.Eng. M.S. Ph.D.
	Hofstra University Hempstead	Solid Waste Management	Cert.
	Hudson Valley Community College Troy	Public Health Technology (Environmental option)	A.A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Hunter College New York City	Environmental Health Science	B.S. M.S.
	Manhattan College New York City	Environmental Engineering and Science	M.S. M.E.
	Polytechnic Institute of New York New York City	Energy Engineering and Policy	Cert. M.S.
		Environmental Engineering and Planning	M.S.C.E. M.E.H.S. Engr. Ph.D.
	Rensselaer Polytechnic Institute Troy	Environmental Engineering	B.S. M.E. M.S. D.E. Ph.D.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
	Rochester Institute of Technology Rochester	Civil Engineering Technology (Environmental option)	B.T.
	State University of New York-Buffalo Buffalo	Water Resources and Environmental Engineering	B.S. M.S. Ph.D.
	State University of New York Farmingdale	Pest Control Technology	A.A.S.
	Syracuse University Syracuse	Chemical Engineering	B.S. M.S. Ph.D.
		Environmental Engineering	B.S.
		Sanitary Engineering, Sanitary Science, Civil Engineering	M.S.(S.E.) M.S.(S.S.) Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	The Cooper Union New York City	Integrated Master's Program with concentration in Environmental Engineering	M.E.
	Ulster County Community College Stone Ridge	Water Quality Management Training	A.A.S.
	University of Rochester Rochester	Toxicology Training Program	M.S. Ph.D.
NC	Duke University Durham	Environmental Management	M.E.M.
		Civil Engineering/ Urban and Environmental Engineering	M.S. Ph.D.
	North Carolina State University Raleigh	Agricultural Pest Control	A.A.S.
		Pest Management	B.S. M.S. (minor)
		Air Conservation	M.S. (minor) M.E. (minor) Ph.D.(minor)
		Environmental Engineering	M.S. M.C.E. Ph.D.
		Acoustic, Noise Vibration	M.S. M.M.E. Ph.D.
	University of North Carolina Chapel Hill	Air and Industrial Hygiene	M.S. M.S.P.H.
		Environmental Chemistry and Biology	M.S. M.S.P.H. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of North Carolina (Cont'd)	Environmental Management Protection	M.S. M.S.P.H. Ph.D.
		Radiological Hygiene	M.S. M.S.P.H. Ph.D.
		Water Resources Engineering	M.S. M.S.P.H. M.S.E.E. Ph.D.
	Wilson County Technical Institute Wilson	Sanitary Landfill Operating Manager	Cert. Diploma A.A.S.
		Sanitary Landfill Technology	A.A.S.
ND	North Dakota State School of Science Wahpeton	Environmental Science Technology	A.A.
OH	Antioch College Yellow Springs	Environmental Studies	B.S.
	Hocking Technical College Nelsonville	Environmental Health Technology	A.A.S.
	Miami University Oxford	Environmental Science	M.En.
	Muskingum Area Technical College Zanesville	Environmental Quality Control Technology	A.A.S.
		Natural Resources Conservation Technology	A.A.S.
		Petroleum Engineering Technology	1-Year Cert. A.A.S.
	Ohio State University Columbus	Agricultural Engineering	B.S. M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Ohio State University (Cont'd)	Chemical Engineering (air)	B.S. M.S. Ph.D.
		Civil Engineering	B.S. M.S. Ph.D.
		Environmental Biology	M.S. Ph.D.
		Environmental Education	B.S.(Ed.) B.S.(N.R.) M.S. Ph.D.
		Toxicology (Pharmacology)	M.S. Ph.D.
	Ohio University Athens	Environmental Studies	M.S.
	Raymond Walters General and Technical College (University of Cincinnati) Cincinnati	Environmental Control/ Protection Technology	A.S.
	University of Cincinnati Cincinnati	Air Pollution and Industrial Hygiene	M.S. Ph.D.
		Civil and Environmental Engineering	M.S. Ph.D.
		Environmental Health	M.S. Ph.D.
		Mechanical and Industrial Engineering (noise)	B.S. M.S. Ph.D.
		Occupational Medicine	M.S. Ph.D.
		Toxicology	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Cincinnati (Cont'd)	Acoustics and Noise Control	B.S. M.S. Ph.D.
	University of Toledo Toledo	Chemical Engineering, Civil Engineering	B.S. M.S.
		Engineering Science	M.S.
OK	East Central Oklahoma State University Ada	Environmental Science	B.S.
	OSU Oklahoma City Technical Institute Oklahoma City	Civil Technology	A.S.
	Oklahoma State University Stillwater	Engineering Technology	A.D. B.S.
		Radiation and Nuclear Engineering Technology	A.D. B.S.
	Oscar Rose Junior College Midwest City	Wastewater Technology	A.A.S.
		Environmental Science	A.A.S.
	University of Oklahoma Norman	Environmental Science	B.S. M.S. Ph.D.
OR	Linn-Benton Community College Albany	Wastewater Technology	A.S.
		Water/Wastewater Technology	A.S.
		Water/Wastewater Plant Operator	Cert.
	Oregon Institute of Technology Klamath Falls	Environmental Technology	A.A.S. B.T.
	Oregon State University Corvallis	Nuclear Engineering Technology	B.S.
		Nuclear Engineering	B.S. M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Oregon State University (Cont'd)	Pest Management and Plant Pathology	B.S. M.S.
	Portland State University Portland	Engineering and Applied Science	B.S. M.S.
PA	Carnegie-Mellon University Carnegie Institute of Technology Pittsburgh	Environmental Engineering	B.S. M.S. Ph.D.
	Drexel University Philadelphia	Environmental Engineering and Science	M.S.E.E. M.S.E.S. Ph.D.
	Pennsylvania State University University Park	Acoustics	M.E. M.S. Ph.D.
		Air Pollution Control Technology	A.A.P.C.T.
		Entomology	B.S. M.Agr. M.S. Ph.D.
		Environmental Engineering	B.S. M.S. M.E.E.E. Ph.D.
		Environmental Pollution Control	M.S. M.E.P.C. M.E.
		Environmental Resource Management	B.S.
		Minerals Processing	M.S. Ph.D.
		Mining Technology	A.A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Pennsylvania State University (Cont'd)	Mining Engineering	B.S. M.S. M.E. Ph.D.
		Nuclear Engineering Technology	A.N.E.T.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
		Petroleum and Natural Gas Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering Technology	B.T.
	Slippery Rock State College Slippery Rock	Environmental Studies	B.S.
	Temple University Philadelphia	Environmental Technology	A.T.
		Environmental Engineering Technology	B.S.
	University of Pennsylvania Philadelphia	Energy Engineering	M.S.E.
		Energy Management and Policy	M.S.E.M.P. Ph.D.
	University of Pittsburgh Pittsburgh	Environmental and Sanitary Engineering	B.S. M.S. Ph.D.
		Environmental Systems Engineering	degrees granted through Engr. Dept.
	School of Public Health (University of Pittsburgh) Pittsburgh	Acoustic Environmental Control	M.S.(Hyg.) D.S.(Hyg.)
		Air Resources	M.S.(Hyg.)

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	School of Public Health (University of Pittsburgh) (Cont'd)	Environmental Health Engineering	M.P.H. D.S.(Hyg.)
		Environmental Health Planning	D.S.(Hyg.)
		Health Aspects of Water Quality	M.S.(Hyg.)
		Industrial Hygiene	M.S.(Hyg.)
		Toxicology	D.S.(Hyg.) Ph.D.
		Radiation Health	M.S.(Hyg.) D.S.(Hyg.) Ph.D. D.P.H.
RI	University of Rhode Island Kingston	Environmental Engineering	B.S. M.S. Ph.D.
SC	Clemson University Clemson	Air Pollution	M.S. M.Engr.
		Natural Systems	M.S. M.Engr.
		Planning and Management	M.S. M.Engr.
		Water Treatment Systems	M.S. M.Engr.
		Environmental Systems Engineering	Ph.D.
	Greenville Technical College Greenville	Wastewater Technology	A.A.S.
	Sumter Area Technical College Sumter	Environmental Engineering Technology	A.E.T.
TN	Chattanooga State Technical Community College Chattanooga	Environmental Science Technology	A.S.
		Nuclear Technology	A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	East Tennessee State University Johnson City	Environmental Health	B.S.E.H. M.S.E.H.
	Memphis State University Memphis	Audiology	M.A. Ph.D.
	Middle Tennessee State University Murfreesboro	Environmental Science and Technology	B.S.
	State Technical Institute at Memphis Memphis	Environmental Engineering Technology	A.E.
	University of Tennessee Knoxville	Environmental Engineering	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Air Quality and Pollution Control)	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Water Pollution Control/Water Resources)	M.S.E.E. M.E. Ph.D.
		Industrial Audiology	M.A.
		Nuclear Engineering	B.S. M.E. M.S. Ph.D.
		Water Resources Development	M.S.
	Vanderbilt University Nashville	Environmental and Water Resources Engineering (EWRE)	B.E.
		Environmental Science	B.S.
		EWRE (Environmental Science)	M.S. M.Eng. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Vanderbilt University (Cont'd)	EWRE (Air Resources)	M.S. M.Eng. Ph.D.
		EWRE (Solid Waste)	M.S. M.Eng. Ph.D.
		EWRE (Water and Wastewater Treatment/Water Resources)	M.S. M.Eng. Ph.D.
TX	Baylor University Waco	Institute of Environmental Studies	B.A. B.S.
	Lamar University Beaumont	Environmental Science	B.S.
		Energy Resource Management	B.S.
	Rice University Houston	Environmental Science and Engineering	M.S.
	Sam Houston State University Huntsville	Environmental Science	B.S.
	Texas A & M University College Station	Environmental Engineering	M.S. Ph.D.
		Entomology	M.S.
		Entomology/Pest Management Option	M. Ag.
	Texas State Technical Institution Waco	Nuclear Technology	A.A.S.
		Water/Wastewater Technology	A.A.S.
		Water Utility Operator	Certificate
	University of Texas Austin	Environmental Health Engineering	M.S. Ph.D.
		Water Resources Engineering	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
UT	Brigham Young University Provo	Chemical Engineering	B.S. M.S.
		Water Resources and Environmental Engineering	B.S. M.S.
	University of Utah Salt Lake City	Civil Engineering	B.S. M.E. M.S. Ph.D.
	Utah State University Logan	Civil and Environmental Engineering	B.S. M.S. Ph.D.
		Pest Management	B.S. M.S.
		Environmental Studies	B.S.
VA	George Washington University NASA-Langley Institute Hampton	Acoustics	M.S. Sc.D.
		Environmental Modeling	M.S.
	J.Sargeant Reynolds Community College Richmond	Environmental Technology Environmental Operations	Cert. A.A.S.
		Ground Water Resources	Cert.
	Virginia Polytechnic Institute and State University Blacksburg	Civil Engineering Technology	B.S.
		Sanitary Engineering/Environmental Sciences and Engineering/Civil Engineering	M.S. Ph.D.
	Wytheville Community College Wytheville	Environmental Technology	Cert.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WA	The Evergreen State College Olympia	Coordinated Studies	B.A.
	University of Washington Seattle	Environmental Studies	B.A. B.S.
		Air Resources	M.S. Ph.D.
	Washington State University Pullman	Environmental Science	B.S. M.S.
		Chemical Engineering	M.S.
		Air Pollution Control Engineering	M.S.
		Air Pollution Science	M.S.
		Air Pollution Option	M.S.
		Air Pollution Program	M.S.
	Western Washington University Bellingham	Environmental Studies	B.S.
WV	Bluefield State College Bluefield	Mining Engineering Technology	A.S. B.S.
	West Virginia Institute of Technology Montgomery	Mining Engineering Technology	A.S.E.M.T. B.E.M.T.
	West Virginia University Morgantown	Engineering of Mines	B.S.
		Environmental Engineering	M.S.C.E. M.S.E.
		Mineral Processing Engineering	B.S. M.S.
		Mineral Resource Economics	M.S.
		Petroleum Engineering	B.S. M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WI	Marquette University Milwaukee	Environmental Engineering	B.A. B.S.
	Northland College Ashland	Environmental Studies	B.A.
	University of Wisconsin-Green Bay Green Bay	Environmental Emphasis	B.A. B.S. M.E.A.S.
	University of Wisconsin-Madison Madison	Civil and Environmental Engineering	B.S.
		Environmental Communications	M.A. M.S.
		Water Resources Management, Environmental Monitoring, Land Resources	M.S. Ph.D.
	University of Wisconsin-Milwaukee	Atmospheric and Marine Environmental Program	M.S. M.E.
WY	Casper College Casper	Water Quality Technology	A.S.
	University of Wyoming Laramie	Civil Engineering	M.S. Ph.D.

Other Programs

The following programs were included in the on-site visit process and offer training through various institutes, centers, state agencies, or college consortiums. Program descriptions can be found in the volume specified.

State	Institution	Program	Volume
FL	Florida Department of Environmental Regulation	Environmental Noise Control Training	Noise
	Miami-Dade Community College	NPDES Effluent Monitoring Training	Wastewater I
		Wastewater Treatment Plant Operations	Wastewater I
		Water Treatment Plant Operations	Potable Water I
	University of Miami School of Medicine	Pesticide Protection	Pesticides
KS	Kansas State University	Institute for Environmental Research	Composite II III Business and Industry
MI	Michigan State University	Institute of Water Research	Potable Water I
		Pesticide Research Center	Pesticides
NE	University of Mid-America	Pests, Pesticides and Pesticide Safety	Pesticides

State	Institution	Program	Volume
NJ	Princeton University	Environmental Science and Policy	Composite I
NC	U.S. Environmental Protection Agency	Air Pollution Training Institute	Air
OH	Ohio State University	Center for Lake Erie Area Research	Potable Water I
		Cooperative Extension Service Activities	Composite II and III
		Water Resources Center	Potable Water I
PA	Air Pollution Control Association	Refresher, Continuing Education Courses	Air
	University of Pittsburgh	Environmental Systems Engineering	Composite I
TN	Memphis State University	Nuclear Reactor Fundamentals	Energy
		Radiation Technician Training Course	Radiation
	Oak Ridge Associated Universities	Radiation Emergency Assistance Center/ Training Site	Radiation
		Special Training	Energy Radiation
	University of Tennessee Center For Health Sciences	Training Courses in Audiometric Orientation	Noise

Photo reprinted from the Marquette University Bulletin 1977-78

PROJECT FINDINGS

Photos reprinted from the Michigan Technological University Catalog 1975-76

I. A SUMMARY PROFILE OF REPRESENTATIVE WATER EDUCATION PROGRAMS

A. States, Institutions, Programs and Degrees

Potable Water Volume I includes 42 programs from 23 states which represent 38 institutions. The programs vary both in size and in description from operator training at the local level to advanced degree programs offered within the universities. This report contains detailed information, gathered from various sources including on-site interviews for the 42 water training programs. Selection of these programs was based on a variety of factors including: information and recommendations obtained during the workforce assessment phase of this project; a review of the institution's program catalog; a review of other published sources of information regarding degree programs in environmental areas.

On-site visits and extensive interviews were conducted to explore each of these programs. Many of the institutions visited have programs in several environmental areas, for example air, solid waste, wastewater, and water. This volume, however, includes only programs which offer a single degree. Program summaries may be found in the section entitled "Potable Water Training Summaries".

Table 8 "A Summary Profile of Potable Water Educational Programs" (refer to Section III) illustrates each program, state, institution and degree. The degrees presented in Potable Water Volume I include: certificate (15%); diploma (5%); associate degree (32%); bachelors degree (12%); masters degree (34%); and, environmental engineer degree (2%). No doctoral programs are presented in this volume. For a more complete representation of the potable water programs, the reader is refered to Potable Water Volume II in conjunction with this volume.

B. Enrollment Statistics and Graduates

The majority (56%) of the programs presented in Potable Water Volume I, enroll at least 11 full-time students, although full-time enrollment includes as few as one and as many as 185. It is noted that seven percent of the programs have no full-time students and two percent were unable to supply the information.

As might be anticipated, the certificate, diploma and associate degree level programs normally enroll more part-time than full-time students. This phenomenon is also characteristic of the masters degree program. This is attributed to the fact that these programs, historically, attract the adult student who is employed and is also pursuing additional training and education. In contrast the baccalaureate statistics indicate a predomination of students enrolled full-time.

Graduates range from zero (5% of the programs) to as many as 185 annually. It is noted that 9% of the programs were unable to supply graduate statistics.

The majority of the programs (68%) are described as stable relative to enrollment and graduate trends. Although four percent were categorized as information not available, 22% of the programs are experiencing an upward change, while six percent report a slight downward trend.

The table on the following page (Table 2) depicts the student enrollment, average number of graduates per year, and changes in enrollment and graduates for those programs presented in Potable Water Volume I. For a more complete representation of all of the programs included, the reader is referred to Potable Water Volume II (multiple degree offerings).

TABLE 2

POTABLE WATER ENROLLMENT PROFILE SUMMARY

Degree	Enrollment Full-Time/Part-Time		Graduates Average # Per Year	Graduate-Enrollment Change By Program Up / Down / Stable		
Certificate	200	1,041	96	0	0	3
Diploma	110	0	55	0	0	2
Associate	262	39	12	6	1	3
Bachelors	190	4	17	1	0	3
Masters	154	283	19	5	2	6
Env. Eng.	3	0	2	0	0	1
Doctoral	0	0	0	0	0	0
TOTAL	919	1,367	201	12	3	18

C. Student Origin

Potable Water Volume I includes 42 programs in which the student origin predominately (87%) is characterized as in-state. Approximately 22% of the programs report 100% of the students as originating from within the state. It is noted that 6% of the programs did not report the student origin.

Of the 23 states represented in Potable Water Volume I, five reported foreign students. The states were Hawaii, Kansas, Maryland, New York, and Tennessee. These states have identified, within the represented programs, foreign student enrollments of 10% to 20%.

D. Employment

Table 4 is presented on the following page and illustrates the employment profiles for the students involved in the programs which are presented in this volume. The majority of the certificate, diploma and associate degree graduates acquire positions in government. These positions are usually at the local level as municipal water treatment plant operators. Similarly, a number of these graduates move to the private sector primarily as industrial treatment plant operators. Due to the unique needs of many of the private sector water treatment plants, the certificate, diploma and associate level graduates are less visible than those water treatment plant operators holding the baccalaureate degree.

At the baccalaureate and the masters level, the trend is toward employment in the private sector. Students graduating with the Bachelor's degree, however, often enter governmental employment in regulatory or state agency roles. Consulting firms (with emphasis on engineering consulting) predominantly employ graduates holding Master's degrees. Persons holding doctoral degrees are fewer in number, and traditionally obtain university employment in the areas of teaching or research.

At present, the student follow-up network does not readily provide for the categorization of the institution's graduates into distinct vocational roles. Although specific entry level positions are often known, most institutions limit their graduate occupational profiles to "government", "industry", and "consulting".

TABLE 3

POTABLE WATER EMPLOYMENT SUMMARY

Degree	Private Sector Industry/Consulting		Total	Government	Other
Certificate	42%	-	42%	58%	-
Diploma	61%	22%	83%	15%	2%
Associate	30%	5%	35%	65%	-
Bachelors	22%	58%	80%	19%	1%
Masters	30%	25%	55%	41%	4%
Env. Eng.	50%		50%	35%	15%
Doctoral	-	-	-	-	-

Graduate employment percentages for individual programs are provided in Table 8, Section III, in four categories: industry, consulting, government, and other. These figures were provided by faculty members as facts or as estimates. The column entitled "Graduate Follow-Up" in Table 8 serves as an indicator of the employment figures' reliability, i.e., if follow-up is not carried out by a program, the employment figures must be regarded as estimates that were made by faculty members. Table 3 (above), compiles employment data from Table 8, giving a total graduate employment picture of the 59 programs surveyed.

Therefore, Table 3 presents employment data compiled from Table 8. Statistics for Table 3 were derived by multiplying the number of program graduates per year by the actual or estimated percentage (of graduates) entering the four indicated categories. Actual numbers were totaled, and weighted percentages were then calculated. By relating the generalized percentages and the number of graduates (from Table 8), the percentages presented in Table 3 are reflective of the actual number of graduates entering the four categories of employment.

E. Faculty

Potable Water Volume I includes a total faculty of 605 persons as depicted on Table 8. Of the total, 465 are full-time (77%) and 140 are part-time (23%). Although a student-faculty ratio can be developed, it would be less than meaningful for the following reasons:

1) some faculty members are engaged primarily in research;
2) a variety of departments supply faculty for occasional courses; and,
3) in addition to their regular course load, some faculty members teach an overload or additional courses.

F. Internship/Applied Study Term

The programs surveyed in this volume include 52% for which an internship or applied study term is required. Programs which do not require this type of activity include 48%. The internship or applied study term is increasing, however, as an area of interest and concern with the educators surveyed. It is anticipated by many of those persons interviewed that an internship component will become, increasingly, an integral requirement for program completion. This facet of the programs will become more predominate especially at the baccalaureate and masters degree level.

In many institutions offering the certificate, diploma and associate degree, the students are already employed. For programs at this level, with a majority of full-time students, an internship is presently, a requirement.

G. Graduate Follow-up

A major factor of the project was the determination of graduate placement from the programs visited. Of the programs presented in Potable Water Volume I, few were able to provide data other than entry level information. Alumni associations, honarary societies and annual department mail surveys are three means frequently reported regarding graduate follow-up. Placement offices and personal contact were also commonly employed in placement of graduates as well as graduate follow-up. Overall, 64% of the programs utilize some form of graduate follow-up. The remaining 36% do not have a graduate follow-up procedure.

II. ADDITIONAL FINDINGS

A. Recruitment Techniques in Potable Water Programs

Recruitment techniques appear as numerous as the programs themselves. The most widespread form of recruitment is by means of distribution of brochures or posters with tear-off cards. Programs at all levels find this to be a most effective method of advertising. It is impossible to determine the percentage of students that actually enroll in a particular program because of exposure to a brochure or poster. However, the majority of the contact people interviewed feel that the response, i.e., students requesting additional information about a program, is quite high.

In addition to brochures and posters, community colleges and technical schools actively solicit students through career orientation day programs, high school visitations, mass mailings to area high school teachers and even newspaper ads. These techniques of recruitment seem to be most effective with over 30% of the students enrolling in a program as a direct result of active recruitment. Personnel already employed in the potable water field are also actively recruited for certification programs and upgrading seminars. Brochures are sent to state operator associations and other employment sites as well as direct mailing to operators.

Undergraduate recruitment closely parallels that of community colleges. Admission offices often send a representative to high schools and community colleges in order to recruit students for their institution rather than recruiting for a particular program. It is within the institution that students are recruited for the potable water programs. The image of program plays a strong role in attracting majors. Word of mouth by students is a very effective method of recruitment.

Graduate programs rarely have hardsell recruitment practices. Posters and brochures sent to undergraduate programs throughout the country are the major methods of recruitment. Some institutions send letters of invitation to outstanding graduates. Word of mouth and annual conventions are also an effective means of attracting students.

A majority of contact persons expressed concern with the difficulty of attracting well qualified undergraduate students to masters and doctoral programs because of the high salaries they receive from the private sector without an advanced degree. This is a particular problem with engineering programs.

B. Research Funding and Sources of Student Support

Research funding and student support play a vital role in the quality of education at the majority of institutions visited. Research money comes from a variety of sources both public and private. Federal agencies such as the Environmental Protection Agency, National Science Foundation, National Institute of Health and the Army Corps of Engineers support a substantial amount of research projects at most major universities. State and municipal agencies also contribute a significant amount of money for research activities at local institutions. Private industry research grants and private consulting contracts generate the majority of funding from the private sector although private foundations also support a small percentage of research projects.

Community colleges and technical schools traditionally receive very little research funding because they are training rather than research institutions. Occasionally EPA, a state or local agency will allocate funds for upgrading existing programs, community education, or further training for water or wastewater treatment plant operators already employed.

The majority of research grants and contracts are directed toward graduate level research and often support both faculty and graduate students. The Environmental Protection Agency is probably the single largest source of research funding. This includes the Office of Water Research and Technology, National Pollution Discharge System and the Federal Water Pollution Control Administration.

Student support is often dependent on the number of research grants a department has a a particular time. The majority of graduate students receive financial assistance in the form of research assistantships, teaching assistantships or graduate fellowships. EPA used to offer a large number of training grants for water and wastewater programs and some schools still receive such grants. The general opinion of persons interviewed is that the training grants should be reinstated in order to compete with the high salaries that undergraduates often receive. Students also support themselves by means of part-time employment or by student loans.

Undergraduate students in need of financial assistance often receive general financial aid packages which include university grants, basic educational opportunity grants, loans, and college work-study. Over 70% of students receive financial aid at private institutions while state supported universities are more affordable and undergraduate students are usually able to meet their financial responsibility.

C. Usage of ERIC and IRIS

ERIC (Educational Resources Information Center) and IRIS (Institutional Resource Information System) are federally maintained computer retrieval systems encompassing educational resource materials on a national scale. IRIS is an EPA generated compilation of information pertaining to water and wastewater. Since the effectiveness of any such system can best be measured by its application and use, this study was appropriately expanded to include an adjunct assessment of the "utilization profile" of the educational community.

It should be pointed out that the respondents to the assessment question, "have you ever used ERIC or IRIS?", were faculty rather than students, and that the findings contained in Table 4 should be interpreted accordingly.

TABLE 4

ERIC/IRIS UTILIZATION PROFILE - WATER

	Yes	No	Total Responding
ERIC	6	27	33
IRIS	8	25	33

Out of 33 total responses, 18% have used ERIC and 24% have used IRIS. Use of these retrieval systems appears consistent throughout the country. In other words, use in one region is not significantly different from use in another. IRIS appears to be utilized more often and is generally used by community colleges and technical schools who specifically deal with water and wastewater training. Most major universities have their own information systems, although ERIC is utilized more at the graduate level.

The following table depicts the use of ERIC and IRIS for all of the environmental areas surveyed and reported. Table 5 illustrates the total number of responses, therefore, as reflected in all of the volumes.

TABLE 5

ERIC/IRIS UTILIZATION PROFILE - NATIONAL SUMMARY

	Yes	No	Total Responding
ERIC	72	307	379
IRIS	64	314	378

D. Program Flexibility

The following table (Table 6) depicts the time requirements for the implementation of a complete content change in a course for those programs included in Potable Water Volume I.

TABLE 6

TIME REQUIRED TO IMPLEMENT A COMPLETE CONTENT CHANGE IN A COURSE

Degree Program	Less than 1 month	1 month-1 year	more than 1 year; less than 2	2-4 years	more than 4 years	Undetermined
Certificate	0	3	0	0	0	3
Diploma	0	0	0	0	0	2
Associate	3	10	0	0	0	0
Bachelors	1	3	0	0	0	1
Masters	1	7	2	0	0	3
Env. Eng.	0	1	0	0	0	0
Doctoral	0	0	0	0	0	0
TOTAL	5	24	2	0	0	9

In order for a program to be responsive to the changing needs of society, time constraints should not be a limiting factor. Table 6 addresses the time needed to implement a new course. The reader should refer to Appendix II "Terminology" for a definition of a course change.

The majority (60%) of programs are able to make a course change within one month to one year. Community colleges technical schools and private four-year institutions are for the most part able to implement course changes within one semester if additional funds or manpower is not needed. Course changes are usually made by department faculty. However, changes which must be approved outside of the department may take the better part of one year and in some cases two years.

State institutions are generally slow in implementing course changes due to the number of committees which must approve. Of the graduate program represented in this volume 15% of the programs take from one to two years. Only 8% of the graduate programs are able to make a course change in one month or less. In most cases, the course is added as an experimental course and may take as long as two years before the course appears in the institution's catalogue.

In contrast, 23% of the associate programs in this volume are able to implement a course change in less than one month. Because associate degree programs are no longer than two years, rapid course implementation is a must. Of all the degree programs represented in this volume, 13% have the capability to implement a course change in less than one month. Generally a course can be added within one semester with 60% of the program responding within one month to one year, 5% of programs require one to two years and 22% of the programs were unable to determine the time needed to implement a course change.

TABLE 7

TIME REQUIRED TO IMPLEMENT A CHANGE IN A PROGRAM SEQUENCE

Degree Program	Less than 1 month	1 month-1 year	more than 1 year; less than 2	2-4 years	more than 4 years	Undetermined
Certificate	0	2	1	0	0	3
Diploma	0	0	0	0	0	2
Associate	1	6	6	0	0	0
Bachelors	0	2	0	1	0	2
Masters	1	5	3	1	0	3
Env. Eng.	0	0	1	0	0	0
Doctoral	0	0	0	0	0	0
TOTAL	2	15	11	2	0	10

Often times it becomes necessary for an educational institution to change its curriculum by adding a new program or by changing a program sequence. Table 7 assesses the time needed to implement a change in a program sequence. The reader is referred to the section "Terminology" for a definition of a program change.

Time constraints vary depending on the nature of the program. If additional faculty, funding or equipment are needed, the program may take as long as five years before it receives approval. However, the majority of programs are able to implement a program change within one year. Programs replacing existing ones are usually implemented within one semester. State universities for the most part have limitations on the number of faculty and students and therefore must replace, rather than add a program. Community colleges and technical schools, often times, must develop a complete curriculum before a new program can be offered. In such cases, approval of a program may take as long as two years. Of all the associate programs represented in the volume, 46% require from one month to one year, and 46% require one to two years and 8% need only one month or less to implement a program change.

Of the 40 programs represented in this volume, 5% need less than one month to implement a program change, 38% require one month to one year, 27% require one to two years, 2% take as long as 3 to 5 years, and 10% are undetermined.

Generally most schools can add a program within one year, but it may take as long as three years to appear in the college catalogue. New programs at some institutions begin as experimental programs and it is only after the need is demonstrated that the program will become official. A new program may also be an out-growth of an existing program which has expanded its scope. Programs of this nature are usually more readily approved because the need and the faculty already exist.

E. Environmental Occupations

Occupations listed below are a result of the contact persons choice of 28 water and wastewater related occupations. In some cases the students are qualified for these positions but do not actually enter them. However, the majority of graduates are employed in occupations with job titles and descriptions similar to those detailed below.

Of the programs represented in this volume at the Certificate, Diploma, or Associate level, the majority graduate students prepared for the following occupations:

Engineering Aide
Safety and Sanitary Inspector
Industrial Waste Inspector
Superintendent - Water and Sewer Systems (Associate or above, not entry level)
Supervisor - Waterworks (not entry level)
Water Analyst
Water/Wastewater Equipment Technician
Water/Wastewater Treatment Operator

A Bachelors program, in most cases includes the above and in addition, the following occupations:

Environmental Engineer
Environmental Engineer - Water Pollution Control
Environmental Engineer - Water Resources
Sanitary Engineer
Chemist
Aquatic Biologist

At the graduate level most students find employment with private consulting firms or governmental agencies as Environmental Engineers. The majority of students enter the following:

Environmental Engineer
Environmental Engineer - Water Pollution Control
Environmental Engineer - Water Resources
Sanitary Engineer
Water Resource Engineer
Superintendent - Water and Sewer Systems
Supervisor - Waterworks
Water Pollution Control Biologist
Health Physicist
Ecologist

The reader is cautioned to remember that job descriptions vary from one level to the next. Therefore, an occupation may occur at both the associate and graduate level such as "Superintendent - Water and Sewer Systems" but job responsibilities will differ.

Students of doctoral programs often enter university positions, which were not listed as an occupational choice. Employment trends showed little variation across standard Federal regions.

Summarizing the occupations demonstrates that graduates of less than four year institutions usually find employment with a municipal or private water/wastewater treatment plant as operators. It is through promotion and continuing education that these people advance to higher level positions. Graduates of these programs have little difficulty in finding employment.

Students with bachelors degrees often return to school for a masters degree after a few years of employment. Those employed with advanced degrees are predominantly products of Environmental or Sanitary Engineering programs. The majority of graduates find employment in their field of study and have a great deal of lateral movement within.

III

A Summary Profile of Representative Educational Programs

The following footnotes (1-6) refer to the various column headings of the Table. Other footnotes are specific to the figures which were provided by various institutions and are used throughout the Table.

[1]Enrollment	1976-77 statistics
[2]Graduates	average for last three years; 'change' indicated apparent trends within that three-year period
[3]Employment	'other' includes positions such as those found within the educational community
[4]Faculty	full-time and part-time is determined by individual institutions
[5]Internship/Applied Study	part of an option to obtain a degree; may or may not have financial reimbursement connected with it
[6]Graduate Follow-up	a standardized procedure that enables the institution to periodically determine the employment of their graduates
NA	Not Applicable/Not Available
*Asterisk	denotes that a program appears in more than one volume of the profile

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES[2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
CO	Community College of Denver-Red Rocks	*Water/ Wastewater Technology	A.A.	79	31	28	Up
FL	Miami-Dade Community College	*Civil Engineering Technology	A.S.	N/A	N/A	N/A	Up
		*Water Treatment Plant Operations	Cert.	0	25	N/A	Stable
	University of Florida	*Training & Research Educations for Environmental Occupations	Cert.	0	500	0	N/A
GA	Atlanta University Center/Georgia Institute of Technology	*Water Pollution Control Design Engineering	B.S./ B.E.	10	0	10	Stable
	West Georgia College	*Water/ Wastewater Operator Training	Cert. (C.E.U.)	0	500	N/A	Stable
HI	University of Hawaii	*Environmental and Sanitary Engineering	M.S.	5	5	8	Down

8

POTABLE WATER EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
100/NA/NA	5%		95%		4	0	X		X	
100/NA/NA		50%	50%		4	11	X			X
100/NA/NA	50%		50%		4	1	X			X
100/NA/NA	50%		50%		2	0	X			X
50/50/ NA	11%	78%	11%		2	30		X	X	
100/NA/NA	30%		70%		2	0	X			X
50/37/13	38%		62%		2	0			X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	PART TIME	GRADUATES [2] No. / YEAR	CHANGE
IN	Purdue University	*Environmental Sciences Option	B.S.	15	0	4	Stable
IA	Kirkwood Community College	*Water and Wastewater Technician	Dipl.	10	0	10	Stable
KS	Kansas State	*Sanitary Engineering	M.S.	1	17	6	Down
LA	Delgado College	*Water/ Wastewater Technology	A.S.	10	0	4	Stable
ME	Eastern Maine Vocational & Technical Institute	*Environmental Control Technology	A.A.S.	28	0	8	Up
MA	Massachusetts Institute of Technology	*Environmental Engineering	E.E.	3	0	2	Stable
	Northeastern University	*Environmental Engineering & Science	M.S.	16	245	43	Stable
	Springfield Technical Community College	*Environmental Technology	A.S.	26	0	10	Up

8

POTABLE WATER EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
67/33/NA	25%		50%	25%	280	0		X		X
100/0/0	10%		90%		1	1	X		X	
80/6/14		7%	63%	30%	2	0		X	X	
95/5/NA	95%		5%		3	10	X		X	
100/NA/NA		20%	80%		2	0	X		X	
NA/NA/NA		50%	35%	15%	N/A	N/A	X			X
90/10/NA	15%	50%	35%		9	0	X		X	
90/10/NA	20%		80%		2	0	X		X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	PART TIME	GRADUATES[2] No. / YEAR	CHANGE
MD	Water & Wastewater Technical School	*Water/ Wastewater Training	1 yr. Dipl.	100	0	100	Stable
MT	Montana State University	*Environmental Health Engineering	M.S.	11	0	7	Up
		*Environmental Engineering	M.S.	7	0	5	Up
	Northern Montana College	*Environmental Health Technology	A.D.	19	0	0	Stable
NE	University of Nebraska	Water Resources Engineering	M.S.	2	30	3	Stable
		Water Resources Planning/ Management	M.S.	6	6	3	Stable
NJ	Middlesex County College	*Environmental Health Science Technology	A.A.S.	15	4	15	Stable
	Steven Institute of Technology	*Water/ Wastewater Engineering	Cert.	4	3	N/A	N/A
NY	Hudson Valley Community College	*Public Health Technology	A.A.S.	45	0	20	Down

8

POTABLE WATER EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
51/34/14	66%	24%	8%	2%	14	1		X	X	
50/50/NA	50%		50%		3	0		X	X	
60/40/NA	60%		40%			0	X		X	
95/5/NA	15%		85%		6	0	X		X	
90/10/NA	40%	30%	30%		1	2		X		X
90/10/NA	40%	30%	30%		0	2		X		X
100/NA/NA	83%		17%		4	0	X		X	
NA/NA/NA	N/A	N/A	N/A	N/A	1	1		X		X
90/10/NA	15%		85%		1	1		X	X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES [2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
NY	Manhattan College	*Environmental Engineering and Science	M.S.	10	13	2	Stable
			M.E.	19	1	18	Stable
	Rochester Institute of Technology	*Civil Engineering Technology	B.T.	120	4	35	Up
	Ulster Community College	*Water Quality Monitoring Training	A.A.S.	34	0	17	Up
OH	Muskingum Area Technical College	*Environmental Quality Control Technology	A.A.S.	26	4	8	Up
PA	Pennsylvania State University	*Environmental Pollution Control	M.S.	25	1	14	Stable
			M.E.P.C.				Stable
			M.E.				Stable
	Pennsylvania State University-Capital Campus	*Water Resources Engineering Technology	B.T.	45	0	20	Stable
SC	Clemson University	*Planning & Management	M.S./ M.E.	5	N/A	4	Stable
		*Water Treatment Systems	M.S./ M.E.	25	N/A	25	Stable
	Sumter Area Technical College	*Environmental Engineering Technology	A.E.T.	28	0	4	Stable

8

POTABLE WATER EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
NA/NA/10	25%	25%	40%	10%	4	1	X			X
NA/NA/10	25%	25%	40%	10%			X			X
80/20/NA	30%	60%	10%		4	2	X		X	
50/50/NA	40%	20%	40%		20	0	X		X	
99/1/NA	20%	20%	60%		2	0	X		X	
50/50/NA	50%		30%	20%	N/A	40		X	X	
50/50/NA	50%		30%	20%	N/A			X	X	
50/50/NA	50%		30%	20%	N/A			X	X	
80/20/NA	25%	45%	30%		5	0		X	X	
40/60/NA	15%	20%	65%		7	10		X	X	
40/60/NA	33%	33%	34%		7	10		X	X	
90/10/NA	20%		80%		2	0	X		X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

				ENROLLMENT[1]		GRADUATES[2]	
STATE	INSTITUTION	PROGRAM	DEGREE	FULL TIME	PART TIME	No. / YEAR	CHANGE
TN	Operator Training Center	*Water/ Wastewater Technology	Cert.	185	0	185	Stable
	University of Tennessee	Water Resources	M.S.	10	0	4	Stable
TX	Rice University	*Environmental Science and Engineering	M.S.	15	1	5	Stable
	Texas State Technical Institute	*Water and Wastewater Technology	A.A.S.	49	2	16	Stable
VA	J. Sargeant Reynolds Community College	Ground Water Resources	Cert.	11	13	6	Stable
	Virginia Polytechnic Institute	*Civil Engineering Technology	B.S.	52	0	20	Stable
WV	West Virginia University	*Environmental Engineering	M.S./ M.S.E.	20	0	10	Stable
WY	Casper College	*Water Quality Technology	A.A.S.	6	0	3	Stable
	University of Wyoming	*Environmental Engineering	M.S.	10	0	3	Up

8

POTABLE WATER EDUCATIONAL PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
100/NA/NA	50%		50%		6	0	X		X	
80/NA/20	30%		70%		1	N/A		X		X
10/90/NA	95%		1%	4%	39	9		X	X	
90/10/NA	63%		37%		2	0	X		X	
20/25/55	90%	10%			1	1		X		X
80/20/NA	10%	70%	20%		2	0	X		X	
NA/NA/NA	15%	10%	75%		5	3		X		X
100/NA/NA			100%		5	0		X	X	
99/1/NA	15%	75%	10%		4	4		X	X	

Photo reprinted from the
Michigan Technological
University Catalog 1975-76

PROJECT COMMENTARY

Photo reprinted from the
University of Missouri,
Columbia Bulletin 1977

PROJECT CONSTRAINTS

In preparation for the on-site interviews, all of the institutions' catalogs were intensively reviewed in order to determine where environmental programs were being offered. During the course of this study, 171 institutions were visited and a total of 338 environmental programs, representing 45 states and Washington, D.C., were surveyed in detail. Albeit significant, these programs represent only a portion of all such programs available and cannot be construed as an in-depth survey of all environmental programs. It is, however, a representative sample within each of the environmental pollution control areas of Air, Noise, Pesticides, Radiation, Water and Wastewater, Solid Waste and Energy.

Several constraining factors to the proposed comprehensiveness of the study were encountered while collecting data from the institutions. It was disappointing to find that definitive records or statistics were generally unavailable which would describe specifically the placement of environmental program graduates. General indications of placement within categories, such as government or industry, were often available in percentages only. Depending on the size of the program and its age, some contact people could describe all graduates, others knew only where the past year's graduates were presently employed, and still others were aware only of their advisees entry-level positions and subsequent moves.

It also became clear during the on-site interviews that some programs of similar or identical content had different titles. This lack of clarity within the environmental areas serves to confuse the casual reader. For that reason, attention must be directed to the actual environmental course listings included in each program summary.

A list of terms commonly used during the on-site interviews and subsequently in this report was developed in order to facilitate precise data gathering. The reader is directed to Appendix II, TERMINOLOGY.

No attempt was made, in this report, to qualitatively judge any of these programs. The apparent absence of substantial qualitative measures in the environmental education field in general and the desire to collect data in a neutral atmosphere underscore the reasons for this omission. It appears that there is a need for the development of an environmental program model in each of these areas in order that some qualitative standards be provided where none now exist.

PROJECT COMMENTARY

Potable Water Volume I presents a survey of post-secondary educational programs that are representative of the training and education of persons in the field of potable water and potable water treatment facilities. Although potable water programs are being conducted in all of the states at academic levels ranging from certification to doctoral and professional degrees, not all states and not all degrees are herewithin presented.

This volume introduces 42 programs from 23 states which include 38 post-secondary educational institutions. A total of 2,286 students (part-time and full-time) are presented in this volume at the certificate, diploma, associate degree, bachelors degree and environmental engineer degree level. The preponderance of programs presented in Potable Water Volume I are associate degree (32%) and masters degree (34%) level programs.

Graduates of associate degree programs and technical schools, often obtain employment in the government sector. The majority of these students currently are employed in municipal water treatment and water distribution plants. Those who are unemployed will seek employment in these plants. In contrast, the majority of students with bachelors and advanced degrees seek employment in the private sector with industrial and consulting firms. Graduates employed by the private sector, traditionally demand (and receive) salaries which are above the usual public sector renumerations. There appears to be a more active recruitment of graduates effort on the part of the private sector. These factors contribute heavily to the graduate's decision to enter the private sector as opposed to the public sector.

Trends, as well as similarities, of programs may be noted by review of the information presented in this volume. Primarily the image of environmental programs, within most of the institutions, was reported as quite favorable. The general environmental science programs often include course offerings from several of the science disciplines. Many of these programs are oriented toward the production of graduates characterized by broadbased academic training, known as generalists rather than specialists. These graduates are described as prepared to address a multitude of environmental problems and solutions.

The environmental engineering programs are often quite stringent academically, and endeavor to maintain the qualities and requirements of the traditional engineering schools. The placement of graduates has been reported, by the environmental engineering programs, as consistently successful. Entry level salary offerings are usually excellent. The baccalaureate graduate often must choose between continuing higher education and the immediate availability of comparatively high wages.

Overall, the programs emphasizing broad-based training which historically have graduated the "general environmentalist" are addressing the need to increase the rigor of program requirements in order to prepare students for entrance into the workforce. The very general environmental programs, characteristic of the early 70s, which lacked emphasis on rigorous training in one or more of the disciplines, appear to be on the decline. There is a definite trend towards up-grading program requirements as well as academic content.

The majority of educators involved in potable water training who were interviewed, forecast a bright future for those entering the field. Due to federal legislation, such as the Safe Drinking Water Act

(PL 93-523) of 1974, workforce demands are increasing in the area of potable water pollution, control and abatement. Of the programs presented in Potable Water Volume I, only 9% are characterized by declining enrollment. The majority of the programs (55%) are reported as stable, currently, and, personnel anticipate a continuation of this trend for the next five years. Increasing enrollments and graduates were reported by 36% of the programs. Table 2 depicts the enrollment distribution, in summary form, for this volume.

Although the number of students entering environmental and sanitary engineering programs is increasing, the educators who were interviewed do not view the number of these programs as increasing. Rather, many professors expressed the feelings that there will be a consolidation of programs and staff to reflect the more rigorous disciplines.

There is a growing concern among educators regarding the recruitment of students for graduate programs. The availability of U.S. EPA training grants for student support has declined. This factor, in conjunction with the comparatively high salaries offered to baccalaureate students, tends to inhibit enrollment in graduate level programs. The overwhelming majority of program personnel interviewed, favored substantial increases in both availability and dollar amounts of these training grants.

Many of the sanitary engineering programs surveyed are illustrating a gradual shifting in emphasis from the area of wastewater to the area of potable water and solid waste management. Other educators stated the opinions that the federal government is directing more funding allocations to energy development with a subsequent relaxation of environmental standards. This decrease in availability of federal monies impacts programs in several environmental areas (in addition to potable water) such as air and wastewater.

In general, the educators interviewed expressed optimism regarding the future of graduates of potable water programs. There is an increase in continuing education programs to meet the needs of operators and of technicians. The importance of the internship or applied study term is receiving growing attention. The increased number of available jobs, as well as the increasing salaries at most levels, tend to attract well qualified students to the field of potable water treatment and distribution employment. Continued legislative activity, as well as increased federal funding allocations could play an important role in improving and maintaining the quality of our environment, through the support of high caliber training and education directed to meet the nation's future manpower needs.

LIST OF POTABLE WATER TRAINING INSTITUTIONS BY DEGREE

Photo reprinted from the Michigan Technological University Catalog 1975-76

POTABLE WATER

VOLUME I

PROGRAMS

Section Page

I. CERTIFICATE PROGRAMS

J. Sargeant Reynolds Community College 91
Miami-Dade Community College 95
National Training & Operational Technology Center. 99
Operator Training Center 105
Stevens Institute of Technology. 111
University of Florida. 113
West Georgia College 117

II. DIPLOMA PROGRAMS

Kirkwood Community College 125
Water & Wastewater Technical School 129

III. ASSOCIATE DEGREE PROGRAMS

Casper College 137
Community College of Denver-Red Rocks. 141
Delgado College 145
Eastern Maine Vocational Technical Institute 149
Hudson Valley Community College. 153
Miami-Dade College 157
Middlesex County College 161
Muskingum Area Technical College 165
Northern Montana College 171
Springfield Technical Community College. 175
Sumter Area Technical College. 179
Texas State Technical Institute 183
Ulster County Community College 187

IV. BACHELOR'S DEGREE PROGRAMS

Atlantic University Center-Georgia Institute of Technology . 193
Purdue University 197
Rochester Institute of Technology 201
The Pennsylvania State University-Capitol Campus 205
Virginia Polytechnic Institute & State University 209

Page

V. MASTER'S DEGREE PROGRAMS

Clemson University 215
Clemson University 221
Kansas State University 227
Manhattan College. 231
Montana State University 235
Northeastern University. 239
Rice University 243
The Pennsylvania State University 245
University of Hawaii 251
University of Nebraska 255
University of Tennessee 259
University of Wyoming 263
West Virginia University 267

VI. ENVIRONMENTAL ENGINEER PROGRAMS

Massachusetts Institute of Technology 273

VII. NON-INSTITUTIONAL PROGRAMS

Michigan State University 279
The Ohio State University 283
The Ohio State University 285

POTABLE WATER TRAINING SUMMARIES

Photos reprinted from the
Northland College Catalog
1975-76

SECTION I - CERTIFICATE PROGRAMS

- J. Sargeant Reynolds Community College
- Miami-Dade Community College
- National Training & Operational Center (NTOTC)
- Operator Training Center
- Stevens Institute of Technology
- University of Florida
- West Georgia College

INSTITUTION: J. SARGEANT REYNOLDS COMMUNITY COLLEGE

PROGRAM: Ground Water Resources
DEPARTMENT: NA
DEGREE: Certificate in Ground Water Resources

CONTACT: H.M. Townsend
Program Head, Ground Water Resources
J. Sargeant Reynolds Community College
P.O. Box 12084
Richmond, Virginia 23241
(804) 264-2792

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Ground Water Resources is a one year certificate program designed to provide students with the fundamentals and experiences necessary for employment in the water well or ground water industry.

The program is currently in its fourth year, having begun in the fall of 1973. Through this program, students are prepared for careers as technicians in various capacities such as consulting technicians, pump installer, sales representative for equipment manufacturers, and workers on drilling rigs. There are only two known similar programs in the nation, at Chemtka Junior College in Salem, Oregon and Staples Vocation-Technical School in Staples, Minnesota.

This program was initiated with the help of a federal grant and currently receives funding from the Coastal Plains Commission for equipment. Because of the practical nature of the program, there is extensive use of drilling equipment and audio-visual materials, much of it donated by manufacturers.

PROGRAM REQUIREMENTS

Admission requirements to the certificate programs are the same as those for admission to the college, a high school diploma or its equivalent or at least 18 years of age and able to benefit from a program of instruction.

The program is four quarters in length (which is normally completed in one year). There are sixty-six hours of credit required for the certificate, which includes forty nine hours of lab work. The program composition is alike for all students; no electives are included in the sixty-six credit hours. Most courses are in water related subjects such as hydrology, ground water geology, ground water pollution, and water well design. Also included are basic courses in communication skills, technical math, psychology, accounting, and sociology.

A coordinated internship program is a part of the fourth quarter of the program, which provides twenty-five hours of practical field experience.

Financial assistance is currently available to students in several forms, including National Water Works Association Scholarships, the college work-study program, and an annual $1000 scholarship provided by the South Atlantic Well Driller's Jubilee. Beginning in 1978, a full-tuition scholarship will be provided by the Empire State Water Contractor's Association.

CURRENT FACULTY, STUDENTS, GRADUATES

The faculty of the ground water resources program consists of one full-time and one part-time teacher. All faculty time is devoted to teaching.

There are presently eleven students enrolled full-time in the program and thirteen part-time students (all foreign) enrolled. About twenty percent of the students normally come from Virginia while the remainder come primarily from eastern states and foreign countries. The program averages about six graduates per year, a level which has remained stable since the program began.

Most of the students are recruited through a booth set up at annual conventions of the National Water Works Association and the South Atlantic Well Driller's Jubilee and through industry association with the program. Graduates are usually placed in employment by similar means of industry contact. Because the program is designed to be terminal, almost all the graduates immediately find employment with industry and few go on for further education.

PROGRAM PROJECTIONS

The current expectation is to expand the program to two years in length and offer an Associate in Science Degree. Officials hope that this can be accomplished within a year or two. Expansion would require the addition of one or two faculty members and additional physical facilities. The certificate program would be continued along with the associate degree program.

ADDITIONAL INFORMATION

In addition to the certificate program the ground water resources program offers several specialized workshops for private industry and government officials. Students are also welcome to attend. Nine such workshops were offered in 1976-77, three of these for the

State Health Department. Some of the proposed workshops for 1977-1978 include: Basic Well Hydrology, Ground Water Geology, Well Logging, Topographic and Geologic Mapping, Water Systems, Rotary Drilling Techniques, Well Design, and Geophysical Methods for Ground Water Exploration.

COURSE DESCRIPTION

GWRD 116 Chemistry of Ground Water - The chemistry of ground water based upon the use of water analysis field kits. (4 q.h.)

GWRD 117 Physics for Ground Water - The basic concepts and laws of physics with emphasis on the mechanics of fluids. (4 q.h.)

GWRD 126 Ground Water Geology - The composition and structure of the earth as a whole, and the various modifying agencies at work on the earth, and their effects on the occurrence of ground water. (4 q.h.)

GWRD 127 Mineralogy and Petrology - The study of minerals including crystalline structure, properties, genesis of minerals, and occurence of the important rock forming minerals. Genesis, properties, occurrence, and uses of igneous, sedimentary, and metamorphic rocks. (4 q.h.)

GWRD 128 Ground Water Pollution - The study of the sources of pollution and its effect on the ground water regime. (2 q.h.)

GWRD 129 Water Well Logging - The various types and uses of mechanical, electrical, and seismic logs, measurement of water levels identification of various geological formations penetrated, aquifer tests and data. (3 q.h.)

GWRD 130 Water Well Design - The principles involved in the selection of materials to be used in the structure portion of the well including casing, screens, grouting, and the sanitary protection of the well. (4 q.h.)

GWRD 137 Water Systems - Water systems as applicable to all types of demand and the selection of proper pumping equipment. (3 q.h.)

GWRD 138 Hydrology - The fundamental of the movement of water in an aquifer. (3 q.h.)

GWRD 157 Specifications, Standards, and Records - The design of well specifications for various types of installations, identification of materials, cost analysis and records. (3 q.h.)

INSTITUTION: MIAMI-DADE COMMUNITY COLLEGE

PROGRAM: Water Treatment Plant Operations
DEPARTMENT: Engineering
DEGREE: Planned Certificate

CONTACT: Mr. John C. Pistorino, P.E., Chairperson
Department of Engineering
Miami-Dade Community College
South Campus
11011 S.W. 104th Street
Miami, Florida 33176
(305) 596-1225

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The planned certificate program for water treatment plant operators is designed to provide the necessary knowledge to upgrade the skills of those presently employed in water treatment operations. New state law requires an operator to complete an approved training course before each level of certification (basic - Class C, intermediate - Class B, and advanced - Class A); the Florida Department of Environmental Regulation (DER) is the approving agency. Presently, operators may take two key courses in the planned certificate curriculum, "Water Treatment Operations I" and "Water Treatment Operations II", and be eligible to take state certification examinations for Class C. "Water Treatment Operations III" has recently been developed, which was designed to meet the educational and training needs of those wishing to become certified in Class B. DER approval for this course is pending. While the planned certificate can be terminal, it was designed to allow transfer into the two-year Associate of Science degree program in Civil Engineering Technology - Environmental Option.

The need for water treatment operator training for all categories, and the need for standardized curriculum materials, have been enhanced by recent federal and state regulations. Miami-Dade Community College has requested funds from the U.S. Environmental Protection Agency (EPA) to carry out a number of tasks in an effort to fill some of the needs in upgrading skills of water treatment plant operators. These tasks include: testing the effectiveness of the new water treatment manual being prepared by the American Water Works Association by offering training based on the manual largely at the Dade County cold-lime softening plant; developing prototype special skills development courses in water treatment plant operations, in cooperation with the EPA National Training Center; testing prototype instructional packages by offering these courses to local operators and measuring the efficacy of the objectives; offering the courses at key points throughout Florida; and offering the courses at key points throughout EPA Region IV. Requested funds would provide for the development of the courses and the actual training, and would pay tuition and book costs for a limited number of qualified students. Training would be provided at the basic, intermediate, and advanced levels.

Miami-Dade Community College establishes an advisory committee to assist in the planning, implementation, and evaluation of each of its occupational programs. A Water and Wastewater Advisory Committee is made up of eight persons from the water and wastewater industry, and meets several times each year.

PROGRAM REQUIREMENTS

Admission to the college is open to all high school graduates, and to all others eighteen years of age and older. Prerequisites for this program include current employment in a water treatment plant or the consent of the department chairperson. Students considered deficient in areas of knowledge crucial to entering the program, such as basic arithmetic, are referred to the college's Learning Support Service for individualized remedial instruction.

The planned certificate program consists of thirty-two academic credits. The entire curriculum may be completed in three terms: fall, winter, and spring/summer. Students employed full-time may complete the program by taking one or two courses each term on a part-time basis. "Water Treatment Operations I, II and III" are included in the curriculum, as are courses in technical math, expository writing, engineering, chemistry for plant operators, and engineering drawing. It is anticipated that "Water Treatment Operations IV" will be developed and in some way incorporated into the curriculum.

Water treatment classes consist of ninety-six lecture hours and thirty-two hours of laboratory. The laboratory consists of chemical and biological procedures, and operational problem solving sessions with test periods, films, equipment demonstrations or visits to treatment facilities under the guidance of an instructor. A 2.0 cumulative grade point average must be earned for the certificate.

CURRENT FACULTY, STUDENTS, GRADUATES

Four full-time and one part-time faculty members in the Engineering Department provide teaching and administrative support to water and wastewater programs; in most cases functions overlap between these two areas. In addition, approximately ten professionals in the field, from local environmental agencies, utilities and consulting firms also assist in teaching courses on a part-time basis.

Approximately five hundred water and wastewater treatment plant operators have attended operations courses since the inception of the programs (wastewater courses began in 1971, water courses in

1973). Presently, approximately twenty-five students are attending water operations courses. All are currently working in water treatment plants. It is not known how many of these are working towards obtaining the certificate, as most take one or two courses at a time and don't continue the curriculum steadily. No certificates have yet been issued to any students.

Tuition fees are most often paid by the employer. Besides qualifying operators for certification, these courses are often helpful in raising the salaries of the operators that attend.

PROGRAM PROJECTIONS

Program goals have previously been stated in connection with the EPA grant proposal. If funding is not obtained, the water treatment operations curriculum will continue similarly to its current level, with the addition of a "Water Treatment Operations IV" course. The number of students taking operations courses may increase, although information dissemination beyond the Dade County area will of necessity be quite limited. Officials will increase recruitment and publicity efforts for the planned certificate program in the vicinity, which is expected to cause many operators to work towards fulfilling the complete program requirements.

COURSE DESCRIPTION

SAN 151 Water Treatment Operations I - The study of water treatment operations. Orientation to water treatment, development in math and science, rules and regulations, and maintenance of pumps and drivers. (5 s.h.)

SAN 152 Water Treatment Operations II - The study of treatment units - their operation and maintenance, and their relationship to the overall water treatment facility. Mechanical details and operation and maintenance of plant treatment units. The study of various types of water treatment flowsheets - their application in treating types of water supplies. (5 s.h.)

SAN 253 Water Treatment Operations III - The study of water treatment - theory of operation, method of treatment and control techniques. Provides knowledge and skills to perform and interpret laboratory tests, operate and control plant treatment units and other equipment employed in water treatment facilities. (6 s.h.)

SAN 254 Water Treatment Operations IV - The study of materials, methods and techniques employed in water treatment facilities. Provides the student with the knowledge and skills to identify the proper design and construction of plant treatment units with emphasis given to the organization and administration of a water treatment facility including the supervision and management of plant personnel. (6 s.h.)

APM 162 Technical Mathematics I - Basic concepts of arithmetic, APM 162 (Cont'd) - algebra, graphs, geometry, trigonometry, tables, and interpolation needed in technical programs. (3 s.h.)

APC 160 Expository Writing - Objective expository writing, emphasizing written communication of technical information. (3 s.h.)

ENT 170 Engineering Drawing I - Drafting theory, lettering, geometric construction, orthographic and pictorial sketching and drawing. (4 s.h.)

SAN 120 Chemistry for Plant Operators - The study of chemistry (principles, concepts and analysis) and its relationship to water and wastewater treatment operations. The course provides the student with the knowledge and skills necessary to employ chemical concepts in problem solving, prepare standard stock solutions, perform laboratory tests, understand test results, and enable the student to maintain and control the general maintenance of a plant laboratory. (4 s.h.)

ASE 161 Introduction to Engineering - Covers the following topics: the logarithmic make-up of the slide rule, the use of folded and reciprocal scales, logarithmic computations, powers, roots, and trigonometry. Emphasis placed on problem solving and techniques for engineering, science, mathematics and technical students. (2 s.h.)

INSTITUTION: NATIONAL TRAINING AND OPERATIONAL TECHNOLOGY CENTER(NTOTC)
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROGRAM: Water Quality Control Training

DEPARTMENT: Office of Water Program Operations

DEGREE: Continuing Education Units

CONTACT: Mr. Walter G. Gilbert, Director
National Training and Operational Technology Center
U.S. Environmental Protection Agency
26 W. St. Clair
Cincinnati, Ohio 45268
(513) 684-7501

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The U.S. Environmental Protection Agency's National Training and Operational Technology Center serves as the operational focal point for the Office of Water Program Operations in course development, course presentations, and assistance programs to help Federal, State and local government agencies, educational institutions and the private sector to obtain the necessary training and skills required to achieve an effective water pollution control and abatement program. NTOTC actualizes its function through the development of training materials, audio-visual instructional materials and instructor guides and the offering of courses in wastewater treatment, water quality management, biology, and chemical and bacteriological analysis for water quality control. On-site training projects for personnel at wastewater treatment facilities enable NTOTC to train operators, laboratory technicians, managers, and others in the field in process control directed toward improving final effluent quality, while also developing improved process control techniques and new training materials. NTOTC serves primarily, however, to help states and regions establish self-sufficiency in their own training programs.

Satisfactory completion of classroom and laboratory courses at the Cincinnati center or in NTOTC training elsewhere results in the awarding of continuing education units to the participants. Since 1970, over 300 courses have given practical training to over 7,000 students at the NTOTC headquarters and across the country.

A major part of the NTOTC operation is the Instructional Resources Center whose purpose is to systematically inventory, maintain, and disseminate current pollution control training and education materials. An Instructional Resources Information System (IRIS) provides a computer-based comprehensive listing of these materials. There are approximately 2,700 water pollution control entries presently in IRIS of instructional materials that are available from a variety of sources. The availability of television production and graphic arts facilities as well as specialists in educational media enable NTOTC to produce instructional materials for staff members, professional educators, and trainers. A bulletin distributed nationwide through ERIC (Educational Resources Information Center) provides information on new curriculum materials.

Personnel at NTOTC can help existing educational institutions develop the educational and training programs necessary to provide the trained personnel who can identify pollution problems and their solutions. The linkages between NTOTC and educational institutions are intended to bring an understanding of each other's capabilities. According to NTOTC, environmental pollution and its control and abatement demands continuing education of professionals already in the field and intensive, specialized training of students at the baccalaureate and sub-baccalaureate levels.

A mechanism is needed, however, to improve communications regarding pollution control training needs to the educational community. And beyond that, schools must be willing to modify current curricula to meet pollution control objectives. To this end, NTOTC recently sponsored a meeting of educators in water quality training from all EPA regions to identify problems and explore mutual concerns. Recommendations from participants will be used in formulating policy, procedures, and curriculum materials designed to bring NTOTC closer to its goal--to improve our nation's water quality through education and training.

COURSE DESCRIPTION

Courses Offered in 1977-78:

100.4 Inorganic Analyses in Water Quality Control Programs - With course, student will know the general classes of methods listed as approved in the Federal Register for analysis of inorganic pollutants. Students will perform the test procedures for acidity, alkalinity, hardness, chlorine, total phosphorus, fluoride, nitrate, and nitrite nitrogen, total and suspended solids, turbidity and specific conductance. Other topics are sample handling, NPDES methodology, accuracy, precision and error of data, and elements of quality assurance programs.

100.5 Organic Analyses in Water Quality Control Programs - With course, student will know how to perform analyses for selected organic pollutants listed as approved in the Federal Register. Course topics include NPDES methodology, laboratory safety, dissolved oxygen, five-day biochemical oxygen demand, total organic carbon, oil and grease, surfactants, total Kjeldahl and organic nitrogen, phenol, polychlorinated biphenyls, pesticides, and control of analytical performance. Emphasis is on laboratory operations.

107.4 Analytical Methods for Trace Metals - With course, the student will have knowledge about the theoretical concepts involved in the methods listed in the Federal Register as approved for determining concentrations of trace metals, and will be able to use these methods in a laboratory. Course topics are the four methods cited in the Federal Register for analysis of trace metals in effluent samples: atomic absorption, flame photometry, colorimetry and volumetric analysis. Emphasis is on laboratory operations.

107.5 Atomic Absorption: Applications Technology in Environmental Control - With course, the student will have increased knowledge about operational techniques and troubleshooting procedures for effective use of atomic absorption instrumentation to determine the concentration of metals in water samples. Emphasis will be placed on advances in state of the art in atomic absorption spectrophotometric techniques for environmental surveillance and monitoring. Course topics include application of AA analysis according to NPDES and Drinking Water regulations, sample preparation, instrument calibration and operations, metals most suited to nitrous oxide analysis and attendant problems, EPA methodology, graphite furnace techniques for sensitivity enhancement, and quality control recommendations.

107.6 Gas Chromatography: Application Technology in Environmental Control - With course, the students will have increased knowledge about operational techniques and troubleshooting procedures for effective use of gas chromatographic instrumentation to determine the concentration of organic materials in water samples. Emphasis will be placed on advances in state of the art in gas chromatographic techniques for environmental surveillance and monitoring. Course topics include application of GC analysis according to NPDES and Drinking Water regulations; sample preparation; instrument calibration and operation; preparation of columns; detector operation and applications including Ni63, electron capture, flame photometric, conductivity, and mass spectrophotometer; trouble shooting; EPA methodology; quality control recommendations.

120.4 Bacteriological Methods in Water Quality Control Programs - With course, the student will have increased knowledge of all aspects of sampling, analysis and date handling for bacteriological samples as required by Federal Register Guidelines for effluent monitoring and other water quality programs. He/she will also be equipped to conduct similar instruction for others. Course topics include characteristics, occurrence, and significance of bacterial indicators of pollution; criteria and standards of bacteriological water quality; sampling programs; collection and handling samples; standard laboratory test procedures for total and fecal coliforms and fecal streptococci, by membrane filter methods and by multiple dilution tube methods; calculating, summarizing and reporting laboratory data; and analytical quality control procedures. Attention in depth is given to use of instuctional resource provided in this course for the planning and conduct of similar courses in educational and training organizations, or in on-the-job situations.

147.1 Water Quality Indicative Organisms: Mayfly Naiads - With course, the student will be able to use EPA-produced and related identification guides to identify unknown organisms as possible to the species level in samples collected in ambient water quality monitoring programs. Students will learn current classification structure and accepted nomenclature and recognize detailed morphological structures essential to accurate use of EPA-produced identification manuals. Course coverage emphasizes accurate identification through use of taxonomic guides developed by EPA's Environmental Monitoring and Support Laboratory and others. Critical identification will be correlated with existing water quality profiles for specific groups of organisms. Major considerations are biology of the Ephemeroptera, sampling techniques, reference collections and handling, alternate sources of identification, morphology of the immature stages, improving usage of biological keys, and relation of specific identification of organisms to ambient water quality.

149 Bioassay For Toxic And Hazardous Materials - With course, the student will have application knowledge about the most commonly accepted practices and principles involved in the laboratory use of aquatic organisms to detect evaluate toxic and hazardous materials. He/she will be able to select, design, and operate a bioassay conforming to the current edition of Standard Methods for the Examination of Water and Wastewater. The training consists of classroom discussion, laboratory exercises and demonstrations, and demonstration and observation at the Newtown Fish Toxicology Laboratory which employs bioassay and related techniques. Course topics include the nature of the tolerance limit and ways to estimate it; acute, sublethal and chronic toxicity; single species versus community responses; bioassay versus biomonitoring; the role of laboratory versus field studies in water quality and fish kill investigations; chemical determinations associated with bioassay and biomonitoring; experimental organisms--types, sources, health, care and use; the statistical design of bioassay; the interpretation and application of results; case history studies of bioassay; laboratory practice in design and operation of static jar tests according to Standard Methods demonstration and limited practice with flow-through tests.

151 Analytical Quality Control - With course, the student will know how to choose analytical methods acceptable for compliance data, and will be able to inaugurate or to reinforce a program of analytical quality control which will emphasize early recognition, prevention, or correction of factors adversely affecting the validity of analytical data. Course topics include Federal Register regulations pertinent to quality assurance programs and/or laboratory certification; standard methodology; sample handling; laboratory instruments; supplies and services; analytical techniques related to error; graphical treatment of data; pertinent statistics; evaluating analytical skills; control charts; data handling and reporting; personnel; laboratory certification; contracted services; field operations; safety. This is also specific consideration of concerns in Trace Organic Analysis, Radiochemistry, Biology, Microbiology and Field Operations.

161.1 Water Quality and Pollutant Source Monitoring: Field and Laboratory Procedures - With course, the student will be familiar with techniques and instrumentation commonly used to develop data in field monitoring programs, and will understand what is involved in related laboratory operations. Course topics are collection and handling of samples; biological, bacteriological and chemical field laboratory methods; field instrumentation; and flow measurements.

161.2 Planning Monitoring Activities in Water Quality Management Programs - With course, the students will be able to apply recognized techniques to the technical design and implementation of ambient water quality monitoring activities. With instructor quidance, students work step-by-step through the planning phases of a simulated field monitoring activity involving interdisciplinary data development and evaluation. Some formal lecture sessions are included on ancillary topics, among which are mathematical modeling, remote sensing for the detection and evaluation of pollution sources, use of an electronic system in a water quality monitoring program, and data storage and retrieval: the STORET system.

162.2 Biological Treatment Technology - With course, the student will be able to select effective processes for specific treatment requirements, identify design inadequacies in treatment strategies, and distinguish between improper operation and inadequate design as the cause of performance deficiencies. Course topics include biological constraints to process efficiency, conventional and pure oxygen systems of the activated sludge process, trickling filters, lagoons, rotating biological contactors and both aerobic and anaerobic sludge digestion.

172.1 Physical-Chemical Treatment Technology - With course, the student will understand the function of various unit processes used in physical-chemical treatment, be able to evaluate the feasibility of treating a particular wastewater by physical-chemical methods, and to select the appropriate unit process(es) needed to treat a particular type of wastewater. Course topics include PL 92-500 as pertinent; coagulation; gravity separation of solids; carbon adsorption and regeneration; removal of organics, metals, nitrogen and phosphorus; chlorination and alternatives; pilot plant systems; sludge treatment by lime, heat and pyrolysis; land disposal of sludge; and costs of physical-chemical treatment and sludge disposal.

173 Orientation to Municipal Wastewater Treatment - With course, the student will have basic knowledge about the principal methods of municipal wastewater treatment currently in use; significant new or developing methods; and the general design, operational, and maintenance features of municipal wastewater treatment facilities. Incidental to other aspects of the course, the particiapnt will acquire a working vocabulary associated with wastewater treatment facilities and unit processes. Course topics include sources and characteristics of municipal wastewaters; objectives of wastewater treatment; purpose and principles of unit treatment processes; factors considered in their design, operation and maintenance; essentials of performance testing and analytical methodology; and plant staffing and laboratory considerations.

179.1 Conducting Operation and Maintenance Inspections at Municipal Wastewater Treatment Facilities - With course, the student will be familiar with the administrative and technical requirements of O&M inspections conducted by Federal and State regulatory agencies, and will have an entry-level capability to conduct an O&M inspection in a wastewater treatment plant. Course topics include administrative procedures and channels, sources of information about wastewater treatment facilities, gathering information from municipal personnel and records, conduct of the inspector in the field, importance of visual observations, identification of common deficiencies or problems in physical facilities or plant operational practices, need for and preparation of, a clear, concise, and complete inspection report. During the latter half of the course, the students, working in small groups under instructor supervision, conduct a practice inspection at a nearby municipal wastewater treatment plant. Inspection reports, prepared by each group, are presented and evaluated in the classroom.

179.3 Evaluation of Flow Measurement Installations at Wastewater Treatment Facilities - With course, the student will be familiar with a method of evaluating the accuracy of open-channel flow measurement installations at wastewater treatment facilities. Course content pertains primarily to the use of weirs and flumes as primary measuring devices, and includes standard requirements for installations, maintenance and use; calibration and evaluation procedures; identification of deficiencies; and improving the accuracy of flow records.

301 Methods for Determination of Chemical Contaminants in Drinking Water - With course, the student will know how to perform analyses for the inorganic and organic chemical contaminants listed in the Interim Primary Drinking Water Regulations. Course topics are arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, fluoride, nitrate and organics (chlorinated hydrocarbons, chlorophenoxys, trihalomethanes). Representative methods have been selected for student laboratory assignments. Other considerations are sample handling, quality control, data processing and drinking water regulations.

INSTITUTION: OPERATOR TRAINING CENTER

PROGRAM: Water and Wastewater Treatment
DEPARTMENT: Water and Wastewater Operator Training Center
DEGREE: Certificate of Attendance

CONTACT: Mr. Jack Hughes, Director
Operator Training Center
Route 4, Blanton Drive
Murfreesboro, Tennessee 37130
(615) 898-2737

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

During the first three years of the center's operation (i.e., 1974-1976), of all the operators in the state who took the water or wastewater treatment operator certifying examination, 43 percent passed it. Covering that same period, of those who had received two or more weeks of training at the center 64 percent made passing grades, and of those who attended three or more weeks during the two years prior to taking the examination 72 percent received passing grades. Operators who attended one week or less did only slightly better than those not receiving any training whatsoever.

In 1972, when Middle Tennessee State University was the site of this training operation, courses were aimed at wastewater treatment operators only. However, in 1974, when the new facility was occupied, a water program began in addition to the wastewater training.

This facility has received extensive funding through federal training grants from the U.S. Environmental Protection Agency (EPA). It is operated by the State of Tennessee Department of Public Health. It should be noted that Tennessee is one of the few states to have an operator training facility which is run by a state environmental agency.

The building houses five faculty offices, two classrooms with a combined seating capacity of 84, two training laboratories, a lunchroom which doubles as a large capacity classroom, and a large open bay demonstration area. The Operator Training Center is situated adjacent to the Murfreesboro Wastewater Treatment Facility, which provides ample observation opportunities and hands-on training support. Nearly all of the students who attend classes are employed at municipal treatment facilities. Instructors from the center make on-the-job visits and thereby maintain a high level of interaction with students.

Courses are made available to a wide range of people in a number of ways. The staff of the center organizes and conducts short schools in conjunction with the certification examinations. These short schools are routinely offered in Jackson, Knoxville, Chattanooga, Johnson City, and Murfreesboro. Recently, a class for collection systems personnel was conducted in Nashville, primarily for Metro Nashville employees. A twenty-six week extended program for water treatment plant operators included classes taught in Chattanooga. Staff members often assist operators on the plant site. This assistance may be structured, as a planned on-the-job training program, or unstructured, as in response to a problem an operator may be having. Two correspondence courses are available to operators, one through Clemson University and the other through the University of California at Sacramento, and are administered in part by members of the staff at the center.

This facility was designed and built exclusively for the training of personnel engaged in water pollution control, and is indicative of the substantial commitment which Tennessee has made in that direction. There is no tuition charged for courses taken at this center, and in many cases books are provided at no charge as well.

PROGRAM REQUIREMENTS

Courses are oriented toward persons who are already employed as operators in various Tennessee municipalities. The state requires one certified operator to be in each facility, so commonly students are seeking the courses which will prepare them for this state certification. Students also seek training which would enhance the possibility of their being promoted.

CURRENT FACULTY, STUDENTS, GRADUATES

At the present time, there are six full-time faculty members employed at the Operator Training Center, including its director. In line with the substantial growth in enrollment, positions for additional faculty have been identified.

Enrollment in wastewater training courses has remained fairly stable from one hundred and seventy-six in 1972 to one hundred and eighty-five in 1977. Courses in water had their first students in 1975, and have grown from one hundred in the first year to one hundred and sixty-two in 1977. Combined training in water and wastewater began in 1974 with sixty-six students and rapidly tripled in size by 1976 (191), but in 1977 the figure dropped to eighty-two students.

Most students are already employed in treatment facilities and course completion commonly results in passing the state certifying examination for operators, which, in turn, results in upgrading occupational status.

PROGRAM PROJECTIONS

One method utilized by the staff to extend the center's effectiveness is to offer classes one day a week at locations in other parts of the state. This allows a course which normally lasts one week to be extended over a five week period and trainees to miss one day of work per week.

Recently, a report was prepared by faculty at the center using EPA staffing guidelines for wastewater systems, in order to determine as accurately as possible the training needs in the state. Long range training needs can be seen from its content. The following table separates all the current operators in the state into categories according to years of experience:

Years of Experience	Wastewater	Water
I. Less than one year	15%	10%
II. One to two years.	10%	10%
III. Two to five years	35%	20%
IV. More than five years	40%	60%

It was determined from these findings that persons in category I need four weeks of training the first year; those in categories II and III need approximately two weeks per year; those in IV need two days per year to maintain skills and stay abreast of new developments.

Ideally, each operator would complete a comprehensive training program, which follows:

1. First year - Basic mathematics, chemistry, and principles of operation. Four weeks.
2. Second year - Mechanical operations and maintenance. Two weeks.
3. Third, fourth, and fifth years - Special operations, e.g., activated sludge, trickling filters, sludge digestion, coagulation and sedimentation, corrosion control, taste and odor problems, or fluoridation. One week.
4. Maintenance of skills - Sixteen hours.

Field instructors will visit operators on their jobs in order to reinforce carry-over of training from the classroom to the work site.

COURSE DESCRIPTION

110-200 Theory and Practice of Waterworks Operations - Theoretical and operational aspects of potable water production. Unit operation, maintenance, and quality control. (Two weeks.)

142-301 Waterworks Microbiology - Disease and taste-and-odor aquatic organisms are identified. Practical treatment methods presented for the removal or prevention of problem-causing organisms in raw water sources and reservoirs. (Two days.)

218-201 Discharge Effects on Receiving Streams - Biological, chemical, and physical properties of receiving streams. Detailed studies of effects of waste treatment effluents are conducted under actual field conditions. (One week.)

310-100 Basic Science Skills Development - Basic chemistry and mathematics. Designed for operators with little or no formal training in these areas. Reviews basic sciences skills needed by an operator. (One week.)

240-100 Collection Systems Workshop - Overview of collection systems, including design, construction methods and materials, maintenance, and safety aspects. (One week.)

210-200 Theory and Practice of Wastewater Operations - Theoretical and operational aspects of wastewater treatment. Unit operation, and maintenance. (Two weeks.)

110-301 Coagulation and Sedimentation (Water) - Coagulation, flocculation, and sedimentation principles and practices. Process optimization is stressed. (Two days.)

210-201 Coagulation and Sedimentation (Wastewater) - Coagulation and sedimentation principles and their application to wastewater. Proper coagulant selection is stressed. (Two weeks.)

322-200 Colorimetric Methods for Metals - Laboratory workshop utilizing colorimetric analysis for the determination of metals. (One week.)

222-211 Chemical Oxygen Demand Laboratory - Principle and application of chemical oxygen demand test are presented and the test is performed. (One day.)

110-301 Hydraulics and Pumping - Practical and theoretical considerations of hydraulics and pumping are presented on the advanced waterworks operator level. (Three days.)

210-101 Lagoon Systems - Principles and practices of lagoon and oxidation pond operation. (Three days.)

210-300 Advanced Wastewater Technology - Theoretical and operational aspects of wastewater treatment. (Unit optimization)

210-300 (Cont'd) - techniques, industrial problems, and tertiary treatment methods. (Two weeks.)

110-300 Advanced Waterworks Technology - Theoretical and operational aspects of advanced water treatment. (Two weeks.)

140-100 Distribution Systems - Overview of distribution systems, including design, construction methods and materials, maintenance, and safety aspects. (One week.)

110-105 Well Systems - Design, construction, operation and maintenance of well systems. (Three days.)

242-301 Wastewater Microbiology - Waste treatment and disease-causing organisms identified. Proper biological growth conditions studied. Public health hazards from biologically treated wastes. (Two days.)

218-202 Oil and Floating Materials - Wastewater treatment processes for removal of oil and floating matter. (Two days.)

INSTITUTION: STEVENS INSTITUTE OF TECHNOLOGY

PROGRAM: Water and Wastewater Engineering (mini-graduate)

DEPARTMENT: Mechanical Engineering

DEGREE: Certificate of Special Study

CONTACT: Dr. Fernando Sisto, Jr. Head
Department of Mechanical Engineering
Stevens Institute of Technology
Castle Point Station
Hoboken, New Jersey 07030
(201) 792-2700

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The mini-graduate program in water and wastewater engineering is designed to educate working professionals at the post-graduate level. This program was initiated in January, 1976.

The program consists of four graduate level courses of an applied nature. A certificate of special study is awarded only after completion of all four courses. All of these courses may also be used toward fulfilling the requirements of the Master of Engineering or Master of Science degree. Courses are offered in the evening for the convenience of working professionals.

PROGRAM REQUIREMENTS

For admission, students must meet the entrance requirements for graduate study in the Department of Mechanical Engineering. Generally, the only prerequisite is a bachelor's degree in engineering or science from an accredited college or university.

The program consists of four courses, two and one-half credits each, for a total of ten credits needed for completion. Two of the courses are offered in the fall semester and the other two in the spring. There are no additional requirements for the certificate.

A Master of Engineering or Science degree requires thirty graduate credits for completion. A student may include the certificate program as one-third of his requirements for the degree and receive both certificate and degree.

CURRENT FACULTY, STUDENTS, GRADUATES

Three faculty members, two full-time and one part-time, are currently participating in the program. About one-half of the faculty time is devoted to research, with the remainder in teaching. Research funding in environmental engineering has been available from the U.S. Public Health Service, the National Science Foundation, EPA, and the US Army.

Presently there are four full-time and three part-time students in the program. The three part-time students are also employed and could be considered career change students. Recruitment has consisted of a brochure sent to water pollution control related industries and consulting firms. Some students from the Mechanical Engineering Department are familiar with the program and have entered it as a result. Most program students receive some sort of financial aid. Employed students usually have their tuition paid by their employer.

The program began in 1976 and has not as yet had any graduates.

PROGRAM PROJECTIONS

Program officials don't expect any expansion in the water and wastewater program in the foreseeable future. They are considering, however, offering certificate programs in environmental planning at some future time.

COURSE DESCRIPTION

ME 133 Biological Treatment of Wastewater Biological basis of wastewater treatment; river-wastewater treatment works analogy; population dynamics: food sources; aerobic and anaerobic systems; the trickling filter and activated sludge processes; reaction kinetics and parameters affecting waste removal; fundamentals of mass transfer. (First semester)

ME 134 Chemical and Physical Treatment of Water and Wastewater A study of the chemical and physical operation involved in treatment of potable and industrial process water and wastewater effluent; topics include chemical treatment, coagulation, flocculation, sedimentation, filtration, disinfection, and tertiary treatment methods; the approach of unit operations and unit processes is stressed. (Second semester)

ME 135 Sanitary Plumbing Systems Laboratory Experimental and analytical treatment of problems of supply of potable water to residential and commercial buildings. Conveyance of wastewater in multistory and multiuse structures. Theoretical and practical bases of codes and design procedures. Aesthetic and economic considerations. Laboratory verification of theoretical concepts involved in design and analysis of systems. (First semester)

INSTITUTION: UNIVERSITY OF FLORIDA

PROGRAM: Training and Research Education for Environmental Occupations (TREEO)
DEPARTMENT: Center for Training, Research and Education for Environmental Occupations
DEGREE: Certification Eligibility

CONTACT: Dr. Richard Palmer, Program Coordinator
TREEO Center
2012 University Avenue, Room 224
University of Florida
Gainesville, Florida 32603
(904) 392-2464

PROGRAM DESCRIPTION:

TREEO is envisioned to be a multipurpose facility which will provide training in environmentally related occupational tasks in direct response to such needs as expressed by the university or by the community. The building which will house TREEO is now under construction and it is hoped that classes will begin in the new facility in January of 1979. TREEO was initially described by the Division of Continuing Education and emerged from it.

The Federal Pollution Control Act of 1970 (PL-92-500), or so-called Muskie Bill, was allocated fifteen billion dollars for its implementation. Each state was then awarded one quarter of a million dollars for the development of training programs in the environmental areas. It was originally intended that each state would supplement these funds and develop programs which are concerned with problem areas which the state identifies. Such was the case in Florida, TREEO being the result.

Even though the building is not complete, attempts are under way to become fully operational. Several community colleges all over the state of Florida have provided the facilities for TREEO workshops which, to date, have served employees of state water and wastewater treatment facilities. In addition to community college involvement, considerable cooperation with state technical-vocational schools exists. The Center will take a coordiantion role in training program development in addition to actual training which will take place there.

Courses will be presented both at the TREEO Center and at convenient locations throughout the state. The presentation will normally be in the form of workshops lasting one to three days.

In addition to the training which will be conducted, it is anticipated that the Center will become an environmental research facility for the state of Florida, in cooperation with the university efforts.

PROGRAM REQUIREMENTS

People wishing to participate in one of TREEO's programs should complete the registration form for the desired course and then either pay the registration fee in advance or on the floor. Anyone may participate, although many of the courses will have a specific application for people who are already employed in a given occupation.

The workshops which are operable at this time are conducted at various locations throughout the state in the area of water and wastewater treatment, including on the University of Florida-Gainesville campus. The purpose of these workshops has been to prepare operators for certifying examinations at their current work level or for the next grade up.

CURRENT FACULTY, STUDENTS, GRADUATES

The current staff consists of a director and an associate director (both part-time) from the College of Engineering, and two full-time program coordinators.

PROGRAM PROJECTIONS

The Center plans to address training toward increasing the broad environmental topics, such as, air pollution control, noise pollution, appropriate land use, and others.

ADDITIONAL INFORMATION

One design feature of the new facility warrants description. A centrally located segment of the building was constructed ot extend over a portion of a pool of water extending across the entire front of the facility. This pool serves the dual purpose of being attractive, while supplying all of the building's water needs, except drinking and cooking. The water will be continually recycled through asystem which has been built in.

COURSE DESCRIPTION (SELECTED)

Water Distribution Systems - This workshop is designed for superintendents and supervisors in water distribution programs. Review and discussion of distribution practices, techniques, materials and equipment, old and new, with the purpose of performance improvement within the industry. COST: $60.00. DURATION: two days.

Increasing Efficiency and Effectiveness Through Proper Supervision - Anyone with supervisory responsibility will find use of this workshop. Attention is given to the supervisor who must carry out front office policy while still working in the field. COST: $150.00. DURATION: two days.

Water Treatment Techniques - Designed for superintendents, lead operators, and design engineers who are responsible for application of techniques necessary to provide a quality drinking water which meets standards set by the Safe Drinking Water Act. Workshop topics include techniques for contaminant removal; cost factors in both operational and physical modifications that may be required; and cost factors in new treatment facilities. COST: $110.00. DURATION: two days.

INSTITUTION: WEST GEORGIA COLLEGE

PROGRAM: Continuing Education for Water and Wastewater Treatment Plant Operators

DEPARTMENT: Georgia Water and Wastewater Institute

DEGREE: Continuing Education Units
Certificate of Achievement

CONTACT: Mr. James W. Bennett, Coordinator
Georgia Water and Wastewater Institute
West Georgia College
Carrollton, Georgia 30117
(404) 834-1468

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

With funds from the state and the U.S. Environmental Protection Agency, the Georgia Environmental Protection Division (EPD) contracts with West Georgia College to provide instructors, space and services to the Georgia Water and Wastewater Institute. Coordination within the EPD is provided by the State Water Grants and Operators Training Program within the Water Protection Branch. The institute was located at South Georgia Vocational-Technical School at Americus until March 1976.

Since the facility moved to its current location, there has been an absence of laboratory classes, as adequate space is not available for laboratory equipment. A facility will be built adjacent to the Carrollton Water Pollution Control Plant; completion is projected for the fall of 1978. Included in the new facility will be classrooms, offices, complete bacteriological and chemical laboratories, and shop and storage areas. Also available to students will be a package aeration treatment plant especially designed for the program, that will be operationally flexible and used for demonstration, and troubleshooting practice.

In addition to conducting the classes of the institute, its instructors also assist in teaching the spring and fall short courses sponsored by the EPD and the Georgia Water and Pollution Control Association, as well as other short courses such as those offered by Clemson University. Under certain conditions, instructors will offer classes in other Georgia cities, or will visit plants that are experiencing problems, and assist with troubleshooting.

PROGRAM REQUIREMENTS

Eighteen courses are presently offered by the institute, with three more planned following the construction of the facility. Each course lasts five days, with six hours of instruction per day. The number of times each course is offered per year varies, based upon the needs. The demands are greatest for the basic wastewater, surface water, and ground water courses. An average of three weeks of classes are held each month.

The mode of training also varies with the course. Among the methods utilized are chalkboard lectures, group discussions of case histories, applications of simplified lab procedures, and audio-visual presentations. Currently used training aids include overheads, films, slides, programmed learning, chlorination and fluoridation equipment, cassettes, and videotapes.

At the present time, academic credit is not offered for completion of the course. Rather, continuing education units (CEU's) are awarded, ranging from one and two-tenths to two and four-tenths units for each course. No tuition fees are charged. As the training program is approved by the State Board of Certification, those that have completed courses are eligible to take state certification examinations in the appropriate category, if all other criteria are met.

Beginning in mid-1978, the Water and Wastewater Institute will offer a certificate of achievement, which will note a significant personal achievement in in-service training. The certificate will be based upon: a) attendance in a prescribed series of short courses at the Institute, and b) successfully passing a comprehensive examination at the completion of the course work. The certification will provide for cross-training, and will carry an option in surface or groundwater treatment, as appropriate. As planned, the program will consist of ten required courses, plus two elective courses, as follows:

Either,

(1) Basic Surface Water Treatment
(2) Advanced Surface Water Treatment
(Surface Water Option)

Or,

(1) Basic Groundwater Treatment
(2) Advanced Groundwater Treatment
(Groundwater Option)

Plus,

(3) Water Distribution Systems
(4) Wastewater Collection Systems
(5) Basic Wastewater Treatment
(6) Advanced Wastewater Treatment
(7) Water Laboratory
(8) Wastewater Laboratory
(9) Mechanical Maintenance
(10) Supervisory Management in Water and Wastewater
(11-12) Students select any two additional course electives, such as Activated Sludge Workshop, Chlorination Workshop, Electrical Maintenace, etc.

As tentatively planned, the comprehensive examination will consist of about six hours of material on a Class I level in water and wastewater treatment, plus more extensive work in laboratory skills, maintenance, and supervision and management.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members currently teach the institute's courses; one specializes in surface and groundwater treatment, the other in wastewater treatment. An estimated three hundred persons attend one or more courses per year; this translates into the equivalent of approximately five hundred participants annually. Attendance in basic classes is limited to twenty, in advanced classes to fifteen. The number of participants in laboratory and maintenance classes may not exceed ten.

Theoretically, any person interested could attend the courses. However, to date every participant has been an employee of a municipal or industrial water or wastewater treatment plant, or of a state or federal regulatory agency.

PROGRAM PROJECTIONS

With the projected move to the new facilities, courses will become more practical, with the use of laboratory facilities, the package plant and access to the adjacent city treatment plant. If the number of faculty members increases, a greater number of students will be accommodated annually.

State EPD officials estimate that in order to meet water and wastewater training needs in the state, expansion of existing programs will be required. As there are no academic vocational programs in these fields in Georgia, officials are considering the development of two new programs within the Georgia Water and Wastewater Institute to fill this present training gap. As proposed, a nine-month technical diploma program in water and wastewater operations will be effected by the fall of 1979. Graduates of this program would be qualified for operation of complex facilities, as well as for managerial positions. If successful, officials will implement an associate degree program in these fields approximately one year later. Graduates of this program would most likely enter management positions such as plant superintendent or supervisor, or shift foreman. These persons would have the knowledge required to deal with nearly any problem that would arise in the most complex facilities.

Implementation of these programs would require additional instructional support. The institute's coordinator estimates that to carry out all proposed plans fully, a full-time administrator would be required, and one full-time instructor in each of the following areas: water, wastewater, laboratory, and maintenance. In seeking instructors, practical operating experience will be stressed, along with ucational requirements. In order to ensure that practical and viable programs are developed, program planning and implementation will take place at a conservative rate; needs and priorities will undergo constant review and re-evaluation. Initially, student enrollment will be limited to ten or fifteen in the diploma program.

COURSE DESCRIPTION

Basic Wastewater - Introduction to wastewater treatment plant operations and maintenance. Pre- and post-tests administered. (8-10/yr.)

Basic Surface Water - Introduction to surface water (stream and lake) treatment plant operations and maintenance. Pre- and post-tests administered. (6/yr.)

Advanced Wastewater - Concentrated study of surface water treatment plant operations and maintenance. Emphasis on application of math and chemistry to operations, troubleshooting, and design. (2/yr.)

Package Aeration Plants - Concentrated study of surface water treatment plant operations and maintenance. Emphasis on daily operations, record-keeping, and troubleshooting. (1/yr.)

Activated Sludge Workshop - Concentrated study of process control of medium and large aerated wastewater treatment plant operations and maintenance. Emphasis on shift operations, record-keeping, and troubleshooting. (2/yr.)

Trickling Filter Workshop - Concentrated study of medium and large trickling filter wastewater treatment plant operations and maintenance. Emphasis on daily operations, record-keeping, and troubleshooting. (0-1/yr.)

Sludge Treatment Workshop - Concentrated study of wastewater sludge treatment and disposal. Emphasis on process control of anaerobic sludge digestion with simplified lab procedures. Discussion of chemical conditioning, vacuum filters, filter presses, centrifuges, etc. (0-1/yr.)

Chemical-Physical Process in Wastewater Treatment - Concentrated study of nutrient and metal removal at the wastewater treatment plant. Emphasis on chemical coagulation and precipitation, including jar tests. (0-1/yr.)

Chlorination Workshop - Concentrated study of the use of chlorine and hypochlorites in water and wastewater treatment. Emphasis on the chemistry of chlorine in water, methods of disinfection, quantitative and qualitative analyses for residual chlorine and handling chlorine safety. (2/yr.)

Fluoridation Workshop - Concentrated study of the use of fluoridation in water treatment. Emphasis on the beneficial effects of fluoride, quantitative and qualitative analyses for fluoride, proper handling and storage of fluoride compounds, and calculations for proper dosage. (0-1/yr.)

Lab Analyses in Wastewater Treatment - Practical laboratory experience in chemical and bacteriological analysis of wastewater. Emphasis on NPDES effluent monitoring. (2/yr.)

Lab Analyses in Water Treatment - Practical laboratory experience in chemical and bacteriological analysis of drinking water. (2/yr.)

Water Distribution Course - Practical experience in water distribution concentrating on pipe, appurtenances, maintenance, disinfection procedures, cross connections, hydraulics of pumping, and effects of storage. (3/yr.)

Groundwater - Introduction to groundwater (well and spring) treatment plant operations and maintenance. Pre- and post-tests administered to gauge comprehension. (5/yr.)

Troubleshooting O & M at Small Municipal Treatment Plants - Practical approach to solving small treatment plant problems. Primarily intended for preparing regulatory agency personnel for carrying out O & M inspections. Emphasis on groundwater systems, ponds, package plants and oxidation ditches. (0-1/yr.)

Wastewater Collection Systems - Practical experience in wastewater collection concentrating on components of the system, maintenance, operation, mathematics, hydraulics, and safety. (2/yr.)

Pond Treatment Workshop - Concentrated study of wastewater stabilization pond treatment operations and maintenance. Emphasis on facultative pond O & M, troubleshooting, and upgrading removal efficiencies through intermittent sand filtration. (0-1/yr.)

Pump Maintenance - Practical experience on preventive maintenance, troubleshooting, and repair. Emphasis on certrifugal pumps. (To be offered in the future)

Electrical Maintenance - Practical experience on preventive maintenance, troubleshooting and repair. Emphasis on motors and controls. (To be offered in the future)

Instrumentation Maintenance - Practical experience on preventive maintenance, troubleshooting and repair. Emphasis on pneumatic and electronic instruments and controls. (To be offered in the future)

SECTION II - DIPLOMA PROGRAMS

- Kirkwood Community College
- Water and Wastewater Technical School

INSTITUTION: KIRKWOOD COMMUNITY COLLEGE

PROGRAM: Water and Wastewater Technician
DEPARTMENT: Environmental Studies and Pollution Control
DEGREE: Diploma

CONTACT: Larry Willis, Career Education
Linn Hall
Kirkwood Community College
Cedar Rapids, Iowa 52406
(319) 398-5498

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This program, four quarters in length, began in the fall of 1974 and is 1,532 contact hours in length. Students are trained to be Water and Wastewater Technicians, and are involved in classroom, laboratory, and practical field learning experience.

A pilot Water and Wastewater plant exists on the campus as a result of the federal funding of $250,000 per state available through the P.L. 92-500, Sec. 109b. Additional funds for the plant's construction were made available from Kirkwood. Waste is fed to the plant from the college enabling students to analyze the biological interactions. It is then returned to the Cedar Rapids sewage system. Treatment is performed at the plant site. Waste Treatment Processes include activate sludge, trickling filter, and rotating biological filter. Operational water treatment facility is complete with softening and chemical addition clarifications.

The plant also has a separate classroom facility with 20 teaching stations and complete wet-laboratory capability.

PROGRAM REQUIREMENTS

For admission, a copy of the high school diploma is required along with an official transcript of each college or university attended. Sixty-six quarter hours of technical core courses and 19 of related courses (chemistry, algebra, microbiology, physics, communication skills) are required for the diploma.

CURRENT FACULTY, STUDENTS, GRADUATES

The staff participates in both teaching and an outreach program. Faculty number five. The credit program has one and one-half full-time equivalent faculty and the remainder participate through outreach. Fifty students per year could be placed if that many graduates existed. Presently the number of graduates is ten. Many graduates have been employed in managerial positions at the treatment plant level.

PROGRAM PROJECTIONS

In the planning stage is a part-time evening program that has been asked for by students. Currently about 25 percent of those who drop out of the day program do so because of money-related problems. It is hoped that this second option will reduce attrition.

ADDITIONAL INFORMATION

The staff instructs students and conducts outreach programs on a state-wide basis. These programs are one-half to two days in length and are offered at strategically located points in Iowa. Approximately 70 modules are available and are being incorporated into the ERIC system as of June, 1978. These workshops are for upgrading of the personnel already in the field. One dollar per contact hour is charged for the outreach program.

A WATS line exists that enables Iowa's 3,000 operators to call Kirkwood and ask questions on any problems of a non-engineering nature.

Above and beyond the diploma and outreach program, KCC does other contracted services. KCC works with Iowa's Department of Public Instruction and has provided a program for wastewater laboratory training in National Pollutants Discharge Elimination System (NPDES). They have developed curriculum modules in Basic Laboratory Skills and Basic Chemistry. Each module contains 4 to 16 hours of instruction. Begun in August, 1977, these modules were offered in each of the six Department of Environmental Quality regions in the state, serving a minimum of 200 operators.

A similar program was offered (January - September, 1977) for water supply system operation. Modules were 8 to 24 hours long in a specific area of water supply system operation (mathematics, wells, Introduction to the Safe Drinking Water Act of 1974, monitoring).

COURSE DESCRIPTION

EV022V Water Resources - Includes evaluation of water resources and availability. The course also covers analysis of water usage trends, concepts of water reuse, and discussion of water tables and geology. (7 q.h.)

EV026V Supervised Field Studies - Offers a period of training in a water or wastewater treatment plant. The student participates in the routine daily operation of the plant. (9 q.h.)

EV027V Water and Wastewater Plant Administration - Offers instruction and practice in planning and conducting an organized system of plant records and reports. Introduction to personnel procedures and municipal management responsibilities in water and wastewater processing. Emphasis on public relations and report writing. (3 q.h.)

EV028V Research Projects - Offers special investigative projects related to water or wastewater plant operations selected by the student with approval of the department advisor. (6 q.h.)

EV029V Water Quality Control - Offers instruction in laboratory procedures/equipment used in the water plant laboratory. (5 q.h.)

EV030V Water Treatment - Offers instruction in water treatment methods, equipment maintenance, and plant control. (11 q.h.)

EV031V Wastewater Treatment - Focuses on design concepts, maintenance and process control of wastewater treatment facilities. The pilot scale wastewater treatment facility is a key training aid. (10 q.h.)

EV032V Wastewater Lab - Includes instruction in laboratory procedures and equipment for assessment of wastewater treatment plant performance and process control. (7 q.h.)

EV033V Water Distribution and Storage - Focuses on design, installation, repair and operation of water system components. (4 q.h.)

EV034V Wastewater Collection - Covers collection of wastewaters by gravity and pumping. Discussion of design, installation, maintenance, repair of components and safety is included. (4 q.h.)

INSTITUTION: WATER AND WASTEWATER TECHNICAL SCHOOL (WWTS)

PROGRAM: Water and Wastewater Training
DEPARTMENT:
DEGREE: One-year Diploma

CONTACT: Dr. Ronald F. Layton, President
Water and Wastewater Technical School
P.O. Box 370
Neosho, Missouri 64850

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Water and Wastewater Technical School, founded in 1959, is devoted solely to the training of water supply and wastewater treatment personnel. Through its one-year course of study and a series of short courses conducted in the United States and around the world, WWTS has gained an international reputation for training in these important environmental areas. Graduates of the program may transfer their academic credits to Crowder College (Neosho, Missouri), Missouri Southern State College (Joplin, Missouri--see elsewhere), Park College (Kansas City, Missouri), and Westmar College (LeMars, Iowa). WWTS also offers correspondence courses on lagoon systems and extended aeration to help operators of small plants understand better their wastewater treatment systems and to assist them in preparing for state certification examinations.

The headquarters of the Missouri Operator Certification Board are located at the Water and Wastewater Technical School. This board is responsible for the administration of the examinations by which qualified students may be granted their Class "C" or Class "D" licenses. Students also have the opportunity to take the Oklahoma "B" or Texas "C" examinations while attending the school. WWTS is accredited by the Accrediting Commission of the National Association of Trade and Technical Schools and by the American Water Works Association.

A new training center (laboratories, classrooms, etc.) is currently under construction at the Neosho campus, and the curriculum is continually evaluated to keep pace with the water/wastewater field technologically. Communication, physics, stream sanitation, and other courses have been added in the past; and courses in solid waste and pesticides are planned. Facilities include an excellent library for study in water and wastewater and equipment for use by faculty and students that covers every phase of these environmental industries (e.g., pipe, pumps, meters, gauges, sewer tapping equipment, sewage treatment plant models). WWTS maintains an extensive set of audiovisual materials for instructional use.

PROGRAM REQUIREMENTS

The one-year course of study at WWTS provides a wide-ranging basic training course in water and wastewater treatment. Students must have a high school diploma or equivalent or agree to complete one prior to receiving a WWTS diploma. In order for a student to graduate and receive a diploma for any program, he/she must maintain a minimum grade average of 60 percent in each class which is a part of the overall curriculum, demonstrate by accomplishment those skills and knowledges necessary to enter the field of water and wastewater management at a basic entry level, and have a satisfactory attendance record. Courses for both the one-year and 12-week programs are listed at the end of this school summary.

CURRENT FACULTY, STUDENTS, GRADUATES

In addition to some consulting work and extensive curriculum material preparation, the fifteen faculty members at WWTS serve 100 full-time enrolled students at Neosho. Coupled with these one-year students, approximately 1,100 more will receive some training in short courses, seminars, etc. during any given year from WWTS faculty. Since its founding in 1959, the Water and Wastewater Technical School has graduated 6,000 individuals from all fifty states and from seventy-three foreign countries. According to its President, the school trained approximately 1,200 individuals in 1975 at its four locations overseas and on the main campus in Missouri. Students are not only drawn from municipal plants for training but also from chemistry and biology fields where jobs are beginning to demand the practical training WWTS provides.

The WWTS course of instruction is designed to train water and sewage plant operators, regulatory technicians (stream monitoring and water and wastewater sampling, analysis, and control), sales and service technicians (customer service, installation and maintanence of equipment), research and development technicians (work with engineers and scientists to develop new research devices and processes), and design and construction technicians (aid in design and construction of water distribution or treatment plants and wastewater collection systems or treatment plants). Past students have returned to work in municipal plants or have taken jobs in the Environmental Protection Agency, the National Park Service, or state environmental offices. Job placement, given the reputation of the program and the faculty contacts in the industry, is not a problem for WWTS students. Roughly 25 percent seek further training in an Associate of Arts, Bachelor of Arts, or master's program beyond their coursework at Neosho.

PROGRAM PROJECTIONS

The growing need for trained operators of water and wastewater treatment facilities, contend school personnel, insures a healthy future for WWTS. Ideally, the faculty would like to see the curriculum expand to include air, underwater work, saline water treatment, and agricultural pollution and wastes; however, these programs are costly and the student demand for them to date has been low. The new facilities soon to be completed in Neosho will enable the facilities soon to be completed in Neosho will enable the faculty to serve more students at one central location than now possible.

COURSE DESCRIPTION (Each quarter totals 420 hours of coursework)

First Quarter:

Chemistry of the Environment - Elements, periodic table, compounds, calculations, chemical equations, disinfection of water and wastewater, acids, bases and salts, solutions, water and its components, ionization, gas laws and their molecular composition, organic chemistry. (78 hrs.)

Metric System for Water and Wastewater - Metric and english systems, basic units of metric systems, conversions from english to metric system and vice versa, practical application AWWA Journal and WPCF Journal. (20 hrs.)

Safety in Water and Wastewater - CPR course and red course multi media course with certification. (24 hrs.)

Field Visits to Water, Wastewater, and Solid Waste Sites - Field trips to water and wastewater facilities in the area are used to illustrate first hand the technical training put into practical use. Different types of plants are visited to emphasize the varied opportunities in the field. (14 hrs.)

Seminars, Tests and Special Project Work - Guest speakers representting manufacturing and distributing companies are welcome to classes; not as an endorsement by WWTS but to allow the students to be acquainted with what is available for use in the water and wastewater plants. Time is also alloted for special instruction requested by students. (9 hrs.)

Second quarter:

Environmental Microbiology - Theory of bacteriological tests, viruses, algae, fungi, protozoa, rotifers, other micro-organisms, microbiology of water and wastewater treatment, laboratory. (40 hrs.)

Electricity for Water and Wastewater - Electrical system and the operator, similarity of electricity to more commonly known facts, kinds of electricity, electrical power fundamentals, distribution and voltage, electrical power, motors, (power to motors) and control. (40 hrs.)

Chlorination and Disinfection Workshop - Chlorinators, troubleshooting chlorinators and practical work, other methods of disinfection. (21 hrs.)

Instrumentation for Water and Wastewater - What is controlled and monitored and why, plant units concerned, components of control and instrumentation, control systems component, field sampling units. (25 hrs.)

Applied Math for Water and Wastewater - Calculators, WWTS slide rule, algebric expressions, geometric figures, area, volumes, math formulas, law of cosines, work problems in workbook, review. (60 hrs.)

Hydraulics for Operators - Density, Archimede's Principle, specific gravity, Pascal's Law, pressures, pressure vs force, heads, friction loss, flow measurement, problems. (50 hrs.)

Hydrology - General introduction, subsurface water, infiltration, run off, evaporation. (20 hrs.)

Field Trips and Field Work - Field trips are carefully selected to demonstrate how technical knowledge needs application. (14 hrs.)

Water and Wastewater Systems - Pump classification, centrifugal pumps, pump maintenance, pump cavitation and pump failures, wells and well pumps, review. (35 hrs.)

Third quarter:

Water Treatment Plant Operations AWWA Course - Sources of water, public health aspects of water supply, ground water treatment, surface water treatment, swimming pools, testing. (50 hrs.)

Water Distribution, Design and Operation and Maintenance - Review of water treatment, discussion on new techniques used in water plants, equipment used and maintenance in water plants, problems encountered by an operator, water storage, distribution system. (50 hrs.)

Water Meters - Meter types, sizes, capacity, uses, maintenance and repair, and how to read a meter. (10 hrs.)

Water Utility Management - Ownership and control, responsibility, management, public relations, rates, engineer. (26 hrs.)

Industrial Water Treatment - Impurities in process and cooling water, industiral process water, cooling water, boiler water treatment. (14 hrs.)

Water Plant Troubleshooting - The sanitary survey, troubleshooting, record evaluation, in-plant evaluation. (14 hrs.)

Saline Water Treatment - Distillation, ion exchange, lab distillation, membrane processes, crystallization. (16 hrs.)

Applied Water and Wastewater Chemistry - Laboratory analysis usage, softening of water, stabilization, testing. (30 hrs.)

Water Plant Laboratory - Physical tests, chemical tests, jar testing. (50 hrs.)

Field Work in Pipe Laying etc. - Ditching and backhoe operation, pipe laying, meter setting. (21 hrs.)

Small Water Systems, Wells etc. - Hydrologic cycle, ground water sources and characteristics, sanitary surveys of ground water and surface sources, wells and spring supplies, disinfection, practical problems in small water systems. (35 hrs.)

Field Trips and Visits to Water Plants - Plants providing information about different sources of water along with various uses of the water are selected during this quarter. (18 hrs.)

In-plant Work at Area Wastewater Plants - The students perform regular operator duties under supervision of plant supervisor and WWTS instructor. Participation in pretreatment, maintenance of equipment, flow measurements, pipe tapping, locating water lines, reading meters, backwashing, laboratory testing, chlorination, pumps, preparation of reports, evaluating the plant, and maintenance are some of the duties the students are asked to perform. (70 hrs.)

Fourth quarter:

Wastewater Treatment Plant Operations - Pollution vs water, laws, criteria vs standards, chemical and biological characteristics, small wastewater plants, primary, secondary and tertiary treatment, management, public relations. (60 hrs.)

Wastewater Collection, Design, Operation and Maintenance - Sewer design, maintenance of sanitary sewers, lift stations and sewage pumps, sewage disposal for residences and institutions. (35 hrs.)

Industrial Waste Treatment - Minimizing and treating industrial waste, thermal pollution, air, plating, textile, cannery, poultry processing, slaughter house and packing, chemical industry and radioactive waste, oil and grease. (30 hrs.)

Advanced Waste Treatment - Oxygen aeration, plastic and wood, phosphorous removal, sand filtration, physical-chemical, carbon absorption, reverse osmosis, BIO-BIXC, ZI,PRO process, nitrogen, carbon removal, distillation and freezing. (30 hrs.)

Ultimate Solids Disposal, Land Application - Sludges, sludge treatment, ultimate disposal. (10 hrs.)

Wastewater Laboratory - Chemical tests, NPDES lab, nitrogen forms. (50 hrs.)

Stream Sanitation and Ecology - Ecosystem, energy, biogeochemical cycles, population biology, aquatic ecology, stream recovery, field trips and laboratory. (50 hrs.)

Activated Sludge Workshop - Overview of activated sludge process, package treatment plants, loading, and plant evaluation. (26 hrs.)

Wastewater Troubleshooting - Public Law 92-500 and interagency cooperation, flow measurement, lab practices, solids handling and land treatment, evaluating treatment plant operations. (25 hrs.)

In-Plant Work at Area Wastewater Plants - On-the-Job Training - Some activities are pre-treatment devices, flow measurement, primary treatment, sludge dewatering, pumps and pumping, secondary treatment, chlorinators and chlorination, grounds maintenance, laboratory tests, and preparation of reports. (70 hrs.)

Field Trips, Visits to Plants - Field trips are in the area of Missouri, Arkansas, and Kansas to plants that offer most demonstrative operational equipment and maintenance situations. (19 hrs.)

SECTION III - ASSOCIATE DEGREE PROGRAMS

- Casper College
- Community College of Denver-Red Rocks
- Delgado College
- Eastern Maine Vocational Technical Institute
- Hudson Valley Community College
- Miami-Dade Community College
- Middlesex Community College
- Muskingum Area Technical College
- Northern Montana College
- Springfield Technical Community College
- Sumter Area Technical College
- Texas State Technical Institute
- Ulster County Community College

INSTITUTION: CASPER COLLEGE

PROGRAM: Water Quality Technology

DEPARTMENT: Biology

DEGREE: Associate of Applied Science (A.A.S.)

CONTACT: Dr. Gail D. Zimmerman
Instructor, Division of Life Sciences
Casper College
125 College Drive
Casper, Wyoming 82601
(307) 268-2542

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Water quality technology is one of two options available within the environmental health curricula. This two year water quality technology program has been an integral part of the Department of Biology, Division of Life Sciences, since 1974.

Although the program is designed to be terminal at the associate level, the student, by means of judicious scheduling and an increase in social sciences and humanities credit hours, could become eligible for transfer to an institution offering the baccalaureate degree.

This program usually does not attract career change students. Often the student is concurrently employed by a water or wastewater treatment plant. Those persons employed in plants often learn of the Casper College program by means of the short schools (one week training sessions) conducted by the faculty across the state. At present, there is no active student recruiting program at the secondary level.

PROGRAM REQUIREMENTS

Admission to Casper College is granted to those residents of Wyoming who have graduated from an accredited high school. There are specific admission criteria for persons who may be adult and continuing students or lack a secondary diploma. Resident status also influences tuition charges.

In order to enroll in the water quality technology program a student completes the first year environmental health curriculum which is closely aligned to the biology major. The student is encouraged to declare his interest in the water quality technology program as early as possible in order to facilitate the summer internship.

The first year courses include the following semester hours: 14 credits English, social sciences and physical education; and 22 credits in biology, chemistry and mathematics.

During the summer, between the first and second year, the student must complete the internship. This activity is accomplished by working full-time for a total of four to six weeks. The students are required to perform tests on water and sewage samples collected from various locations in the State. The students receive four semester credits and are registered in biology 206, water and wastewater analysis.

The second year course work includes the following semester hours: 11 credits bacteriology, microbiology, and physics; 10 credits speech, government, electronics, and blue print reading; and, 11 credits ecology, plant operation, landscaping and metal fabrication.

The students enrolled in the water quality technology program often are able to gain financial assistance for tuition from the state or local agency or treatment plant for which they are employed.

CURRENT FACULTY, STUDENTS, GRADUATES

Currently the faculty is composed of five full-time instructors. Two have the Ph.D. degree and three have at least the M.S. degree. It should be noted that these faculty members are also responsible for the other program concentrations in the biology department. Due to the interfacing nature of these courses, it was not possible to separate the water quality technology faculty from the other areas of concentration. All five are cost centered.

At the present time there are six students at the second year level who are identified as within the water quality technology option. Graduates have averaged three per year over the last two years. Historically, all students have entered or returned to the workforce in positions in water and wastewater treatment plants as operators. Graduates are assisted in job placement by means of personal contacts on the part of the faculty.

PROGRAM PROJECTIONS

There has been a shift in the water and wastewater training emphasis in the State of Wyoming during the last two years. Those activities which were conducted by the state training officer will now be allocated, for the most part, to the College. This shift in state policy and other factors are anticipated to cause some growth in this program. While student enrollment may increase, the number of faculty are expected to remain unchanged. Dramatic expansion in this program, however, will probably not occur during the next two to three years.

COURSE DESCRIPTION

Bio 099 Environmental Biology - Consideration of ecological relationships, natural cycles, and man's place in his environment. Emphasis is placed on eco-systems in Wyoming Four field trips. (3 s.h.)

Bio 101 General Biology I - A study of the cell as a unit of life, the diversity and inter-relationships of living things, the physiology of complex animals, plants, and populations. General biological principles and their relation to man is emphasized. Designed to fulfill the laboratory requirement of non-life science majors including those in education, social sciences, humanities, and English. (4 s.h.)

Bio 102 General Biology II - A survey of the body systems, their functions and mode of action. An introduction to the sciences of genetics, ecology, and speciation. Major features of terrestrial, aquatic, and marine environments and the encroachment of man upon them will be surveyed. (4 s.h.)

Bio 111 Biology I - A detailed study of the plant and animal kingdoms which includes the chemical and cellular basis of life, cells, cellular organizations, energy transformations, gas and nervous controls. The course is designed for life science majors and pre-professional life science curricula. It is anticipated that the students have had one or more years of high school biology, chemistry, and physics. (4 s.h.)

Bio 112 Biology II - Includes the study of effectors and their physiology, behavior, cellular reproduction, patterns of behavior, gene and gene action, development, evolution, ecology. and a survey of the plant and animal kingdoms. (4 s.h.)

Bio 141 Elementary Forestry - General survey of the field of forestry including forestry professions, identification of trees, types of forests, their characteristics, distribution, harvesting, and conservation. (2 s.h.)

Bio 180 Fundamentals of Water Treatment - The topics covered in the fundamental course are mathematics, chemistry, characteristics of water and wastewater, water treatment, sewage treatment, microbiology, plant biology, drinking water regulations, plant records, chlorination, blueprint reading, public relations, amintenance, water distribution, sewage collection, plant safety, discharge permit regulations, and government funding. The courses includes a tour of Casper's water treatment plant and wastewater treatment plant. (1 s.h.)

Bio 181 Water Treatment - A study of water sources, water treatment processes, and distribution systems. Includes maintenance procedures, bacteriological, microbiological, chemical, and radiological monitoring, control by instrumentation, and administration of public water systems. (1 s.h.)

Bio 182 Wastewater Treatment - The course is presented in four sections. The first section deals with a review of mathematics, chemistry, microbiology, and hydraulics. Second covers wastewater characteristics, types of treatment and various unit processes of treatment. Third; covers maintenance and records, stream quality standards, discharge permits, collection systems, and lift stations. Fourth; budget and capital improvements and personnel problems. (1 s.h.)

Bio 201 Natural History of Plants - A survey of the plant kingdom emphasizing structure, evolutionary relationships, systematics, distribution and life cycles of non-vascular and vascular plants. (3 s.h.)

Bio 205 Plant Operation - This course will acquaint the student with the principles of water and wastewater plant operation. Topics emphasized will include safety, mechanical maintenance, record keeping, and laboratory analysis of samples. (3 s.h.)

Bio 206 Water and Wastewater Analysis - A course designed to acquaint the student with collection techniques, proper sample care, data reporting, and laboratory testing of samples. Laboratory tests will include chemical and bacteriological analysis of samples. (4 s.h.)

Bio 210 Human Physiology - The physiology of the cell, tissues, and organs are studied. An explanation of the physiological and chemical reactions of each of the organ systems is given. The effects of various drugs upon cardiac and skeletal muscle are discussed. (3 s.h.)

Bio 213 General Bacteriology - The characteristics of bacteria and the laboratory techniques used in the study for these organisms. (4 s.h.)

Bio 214 Pathogenic Microbiology - A study of disease-producing microorganisms and the laboratory techniques used in the study of these organisms. (3 s.h.)

Bio 242 Invertebrate Zoology - The course will include a survey of the major invertebrate phyla of the animal kingdom. The following biological aspects of each phylum will be studied; evolutionary relationships, life cycles, ecological relationships, structural and taxonomic characteristics, and natural history. (4 s.h.)

Bio 250 General Ecology - Designed to introduce the student to the basic principles of ecology. Topics stressed include the ecosystem, community, succession, aquatic and terrestrial habitats, natural selection, and speciation. Includes two or three field trips. (3 s.h.)

Bio 251 General Ecology Laboratory - A laboratory designed to illustrate the principles of ecology. Principles illustrated will be succession, inter-relationships of plants and animals, and methods of analysis of biotic communities. Individual research project required. Concurrent enrollment in 42--250 for those who desire and need the laboratory experience in their curricula. (1 s.h.)

Bio 290 Research Problems in Biology - A comprehensive research study is required. Upon completing the project, the student should present a paper and oral seminar to a committee selected by the project instructor. The problem and amount of credit received must have the approval of the instructor and the Student Affairs Committee. (Max. 3 s.h.)

INSTITUTION: COMMUNITY COLLEGE OF DENVER-RED ROCKS

PROGRAM: Water/Wastewater Technology
DEPARTMENT: Environmental Training Center
DEGREE: Associate of Arts (A.A.) in Water/Wastewater Technology

CONTACT: Mr. Thomas Feeley
Environmental Training Center
Community College of Denver
Golden, Colorado 80401
(303) 988-6160 x 299

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Water and wastewater training has been on-going at the Red Rocks campus of the Community College of Denver, at least since 1970. With the advent of the 1972 Amendments to the Federal Water Pollution Control Act (PL 92-500) Section 109(b), the college applied for and received grant funds from the U.S. Environmental Protection Agency to construct a wastewater treatment facility in order to provide training to persons in the field as well as to new entrants.

Today, the Environmental Training Center is being constructed on the Red Rocks Campus pursuant to the grant monies under Section 109(b). The Center will be a separate building containing the most up-to-date facilities for hands-on, experiential training of water and wastewater plant operators. The facilities will also be uitlized by other environmental technology programs.

The water/wastewater technology program provides training for entry-level, as well as for up-grading of plant operators. The program successfully combines classroom instruction with experiential, on-the-job training. This program addresses the growing instructional needs in the areas of water and wastewater, for the State of Colorado, but eventually the neighboring states will also benefit from this regional center. The water/wastewater technology program leads to the Associate of Arts degree.

PROGRAM REQUIREMENTS

In general, admission to the Community College of Denver is granted to high school graduates, and to non-graduates 18 years of age and above. Tuition costs are minimal and financial assistance is available to students.

The water/wastewater technology program normally is a two-year program for those students desiring to complete the requirements for the associate degree. In order to be eligible for the Associate of Arts degree in water/wastewater technology, the following requirements must be successfully completed:

Course	Quarter Hours
Water/wastewater courses	51
Science	17
Mathematics	6
Social Science	3
Communication	6
Industrial occupations	4
Related electives	3
Business and management	6
Total credits required	96

In addition to the above classroom and laboratory requirements, the students must obtain on-the-job experience. These experiences are coordinated by the college personnel and include a variety of water and wastewater facilities (numbering at least 18) throughout the area.

Typical of the occupations which these students enter are the following, in partical listing: recycling operator; sanitary landfill operator; water and/or wastewater treatment plant operator; and, environmental monitor, analyst, specialist.

CURRENT FACULTY, STUDENTS, GRADUATES

The current full-time faculty associated with the water/wastewater technology program is four. Two of these persons are cost-centered. There are a number of supporting personnel from other areas that interact with the students of this program. Those part-time personnel number approximately 50.

Enrollment, in the water/wastewater technology programs, includes approximately 110 students. Of the total, approximately 25% to 30% are full-time. At present, the complement of females is four. The faculty, however, is endeavoring to overcome what may be termed historical prejudice, to women entering the field.

In addition to the associate degree students, there are approximately 120 to 130 part-time students annually, receiving training in wastewater laboratory methods. Upon completion, these students are awarded a certificate of competency.

The average number of graduates over the last three years has approximated 14 per year. In 1976-77, however, 28 were recipients of the associate degree. Historically, one person each year elects to continue their education through the baccalaureate degree. Predominantly the students have chosen Metropolitan State College in Denver.

PROGRAM PROJECTIONS

In examining this program, it is impossible to conclude that the future promises other than growth and expansion. With the completion of the Environmental Training Center, Red Rocks will assume the position as the outstanding center of excellence in the Rocky Mountain region, for water and wastewater training.

Faculty and administrators anticipate not only the expansion of the water/wastewater technology program, but the institution of new environmental programs. An associate level degree program in solid waste management is in the planning stage at present. Should a solid waste management curriculum be developed at Red Rocks, the Environmental Training Center would achieve an even more prominent position in environmental training programs. At present there are very few solid waste programs available in any location of the United States.

Another future plan of the faculty includes the development of a one year program emphasizing training in the potable water area. No timelines have been established for these activities, however.

COURSE DESCRIPTION (Selected)

WWT 100 Introduction to Water-Wastewater - Designed to introduce the student to the characteristic effects of wastewater upon water quality. Treatment operations used to remove objectionable pollutants. Characteristics of water, water treatment, and protection of ground water. (3 s.h.)

WWT 105 Specific Calculations for WW - Designed to familiarize a student with the various math calculations associated with the field of water and wastewater. Areas of study will include manipulation of conversion factors, geometric figures, organic and hydraulic loading problems and chemical dosage and solution problems. (4 s.h.)

WWT 109 Water Distribution - Basic - Designed to introduce the student to the water distribution system and its component parts, operation and equipment used. Some specifics include distribution and service fittings, tappings, valves, hydrants, meters and installation, maintenance and cleaning of water mains. (3 s.h.)

WWT 115 Water Sources and Supply - Study of the aspects of Water Sources and Supply. Included topics will be surface water, ground water, water storage, effects of storage, water shed protection and raw water transmission. (3 s.h.)

WWT 119 WW Chemical Analysis I - Introductory course teaches fundamentals essential to good laboratory operation. Subjects such as laboratory safety, basic concepts concerning atoms and molecules, calculations regarding solubility, reactivities of compounds, pH calculations, etc. to provide a basis for more detailed work in water and wastewater laboratory courses. (5 s.h.)

WWT 120 Water-Wastewater Equipment Maintenance - A course designed to make the student aware of sound practices in general equipment repair and maintenance. Specific tools, prtoective coatings and record keeping are to be stressed. (2 s.h.)

WWT 121 Public Relations for Water-Wastewater - Designed to acquaint WW students with Public Relations and its application to the Water-Wastewater Industry. Topics to be discussed will be: Tools available for a public relations program, obtaining public support, and how to work directly with the public. (3 s.h.)

WWT 206 Blueprint Reading for Water-Wastewater - Instruction in reading and interpreting drawings of treatment works, equipment, distribution and collection systems and introduction to different types of graphical presentation and interpretations and use of various graphs and monographs. (5 s.h.)

WWT 208 Water-Wastewater Administration & Finance - Sound practices in project service costs, rate structure, municipal finance, safety programs and personnel practices are to be taught. (3 s.h.)

WWT 218 Introduction to Computers for WW - Intent of course shall be to acquaint the student with the concepts, terms, and definitions associated with the data proce-sing field. Throughout the length of the course, the subject matter shall be discussed in the light of its application within the utilities field. The student will also be given the opportunity to gain hand-on experience in the programming and operation of the computer. (5 s.h.)

WWT 219 Water Quality Control - This is a course designed to familiarize the WW student with the importance of water quality control. Emphasis will be placed in the development of a quality control program in a water or a wastewater facility. Topics to be covered will be the wastewater permit system, water quality standards, data gathering and data reporting. (3 s.h.)

WWT 225 Sludge Disposal & Chemical Recovery - A study of the methods used for conditioning, drying, and removal of the sludge material from water treatment plants. Topics to be discussed will be methods of recovering the chemicals used in water treatment and their reuse in the treatment plant. (2 s.h.)

INSTITUTION: DELGADO COLLEGE

PROGRAM: Water and Wastewater Technology

DEPARTMENT: Environmental Health

DEGREE: Associate of Science (A.S.), Environmental Health Technology

CONTACT: Dr. Sushil K. Gilotra
Chairman, Environmental Health
Delgado College
New Orleans, Louisiana 70119
(504) 486-7393 x 305

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Instituted in 1973, the water and wastewater technology programs at Delgado College offer training at two levels: the one-year certificate program, and the two-year associate degree program. These two programs were established to meet the increasing needs in the State of Louisiana, for properly trained water and wastewater personnel. The major emphasis of these programs is to prepare students with academic or theoretical knowledge as well as with the hands-on skill training, needed for the water and wastewater fields. The programs include public, municipal and industrial water and wastewater treatment facilities, as well as collection and distribution systems.

The one-year program is oriented towards the water and/or wastewater treatment plant operator. Students complete the two semesters of course work and the practical experiences and are then eligible for a certificate.

The two-year program includes most of the certificate program. In addition, students are prepared as technicians with a strong background in applied environmental health as relates to the areas of water and wastewater. The two-year program leads to the Associate of Science degree.

PROGRAM REQUIREMENTS

Requirements for the one-year certificate program in water/wastewater technology include the successful completion of 30 semester units. The basic program is presented as outlined below:

	Course	Semester Hours
MA 101	Technical Math	3
EH 113	Water Purification	3

Course		Semester Hours
EH 114	Introduction to Wastewater	3
EH 109	Public Health Microbiology	4
CH 101/ 105	Chemistry and lab	5
EH 116	Water Supply & Wastewater Control	3
EH 117	Advanced Wastewater Treatment	3
EH 150/ 250	Practicum	6
Total hours		30

The requirements for the two-year program are similar in the first year although not identical. In order to be eligible for the Associate of Science degree, the student must complete the following requirements:

Course		Semester Hours
First Year:		
EN 141/ 142	English	6
PS 101/ 102	Technical Physics	6
MA 101/ 102	Technical Math	6
CH 101/ 105	Chemistry and lab	5
EH 113	Water Purification	3
EH 114	Wastewater Treatment	3
EG 124	Basic Drafting	3
Second Year:		
BI 271	Microbiology	4
CE 101	Elementary Surveying	3
SS 153	Industrial Relations	3
EE 260	Instrumentation	3
IE 105	Management for Engineers	3
EH 116	Water Supply & Wastewater Control	3
EH 117	Advanced Wastewater Treatment	3
EH	Approved electives	13
Total		35

In addition to the above course work requirements, the student must complete six semester hours of EH 150 and 250 the practicum. This obligation is met during the first and second summers.

CURRENT FACULTY, STUDENTS, GRADUATES

Currently the faculty associated with the water and wastewater technology programs consists of three full-time teaching members. In addition, there are approximately 10 supporting persons who assist with this program on a part-time basis.

Enrollment in the water/wastewater technology program, at present includes 28 male and 13 female students for a total of 41 full-time students. There are no figures currently available for the number of part-time students or for those specifically involved in the certificate level program.

Graduates of this program have averaged approximately four over the last few years. Approximately 30% to 40% of the graduates elect to pursue their studies, usually at McNeese State University in Lake Charles. Those entering the world of work directly from graduation, find employment predominantly in the public sector (95%).

PROGRAM PROJECTIONS

These water and wastewater technology programs have been increasing over the last few years. Indiciations are that the trend of expansion and growth will continue, at least for the next two to three years. In response to program expansion one faculty member will be added within the next three to five years.

COURSE DESCRIPTION

EHT 113 Water Purification - Basic principles of water purification. Aspects of water supplies and quality. (3 s.h.)

EHT 114 Wastewater Treatment - Basic principles of elementary waste disposal by anaerobic and aerobic processes, quantities of waste flow, sampling and testing procedures. (3 s.h.)

EHT 216 Water Distribution and Wastewater Collection - Elementary engineering aspects of water supplies and distribution. (3 s.h.)

EHT 217 Advanced Wastewater Treatment - Advanced methods of wastewater treatment in municipal and industrial collection systems. (3 s.h.)

INSTITUTION: EASTERN MAINE VOCATIONAL TECHNICAL INSTITUTE

PROGRAM: Environmental Control Technology

DEPARTMENT: Environmental Control Technology

DEGREE: Associate of Applied Science

CONTACT: Donald W. Weston, Head
Environmental Control Technology Department
Eastern Maine Vocational Technical Institute
345 Hogan Road
Bangor, Maine 04401
(207) 942-5217

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Environmental Control Technology Program is a two year program leading to the Associate of Applied Science degree. Students receive instruction in basic microbiology, physics, chemistry, sanitation, and wastewater treatment. The program utilizes the latest in laboratory equipment and techniques and students receive instruction in the use of environmentally related instruments. The layout and design of pollution control facilities is also covered in the program's curriculum. It is expected that students will be prepared to accept positions in the fields of research, development, sales, and operation of environmental control equipment. They may hold jobs as waste treatment plant operators, water plant operators, laboratory technicians and engineering technicians.

The Environmental Control Technology program utilizes two laboratories which include pilot water and wastewater treatment plants. Second year students participate in a practicum involving two weeks on the job training at wastewater treatment plants.

PROGRAM REQUIREMENTS

In order to enter this program, the Institute requires satisfactory completion of a four-year high school course or its equivalent. A prospective applicant must also have completed Algebra I, Algebra II, Geometry, Biology and Chemistry. A total of 78 credits are structured in the program curriculum over four semesters (two years). Included in the program is an allowance for two social science electives to be taken for a total of six hours of credit. Environmental Pollution Control courses include:

Environmental Control Technology, Wastewater Treatment; Industrial Waste Treatment; Sanitary Chemistry I & II; Environmental Control; and Instruments and Controls. Important "hands on" experience is provided to the students through the utilization of the pilot water and wastewater treatment plants and the Practicum. Financial aid is available through the Basic Education Opportunity Grant Program, training grant and scholarship programs.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members provide instruction to the program's students. There are currently twenty-eight students (Fall, 1977) enrolled in the program of whom four are female. All of the students are full-time and a few (5 to 6) come into the program as career change students. It is estimated that about eight students receive their associate degree from the program annually. Some of the program's students continue on to other degree programs such as the Sanitary Engineering Program of the University of Maine at Orono or Applied Marine Biology and Oceanography at the Southern Maine Vocational Technical Institute.

It is estimated that most graduates find public sector jobs (80%) and that relatively few (20%) find employment with private business. Program officials estimate that 90% find employment in their field and 8% in a related field. The Institute operates a placement office to assist students in securing employment and this office accepts referrals from employers.

PROGRAM PROJECTIONS

It is anticipated that the Environmental Control Technology Program will attract greater numbers of students or hire additional faculty. Present resources are considered adequate to meet projected needs at this time.

COURSE DESCRIPTION

205 Pipefitter's Drafting - Designed as a one semester program exclusively for Environmental Control students, covering, sewage disposal systems and treatment plants, the fundamentals of blueprint reading, and other areas. (2 s.h.)

303 Technical Writing - Strengthens the technical students' control of written expression and trains him to assemble information. (3 s.h.)

342 Communications for Technologists - This program provides background and practice in the communicative skills for those two-year degree candidates enrolled in technologies. (3 s.h.)

1001 Introduction to Environmental Control - An introductory study of water pollution, including treatment methods, treatment plant operation, and laboratory procedures for water testing. (7 s.h.)

1002 Waste Water Treatment - Emphasis on sewage treatment, including treatment methods, treatment plant operation, and laboratory procedures used in sewage treatment. (5 s.h.)

1003 Industrial Waste Treatment - A course designed to cover industrial waste treatment, including types and nature of wastes, treatment methods, and testing procedures. (7 s.h.)

1004 Environmental Control - Covers other aspects of environmental control, including solid waste handling and disposal, air pollution testing and abatement, and sound pollution and abatement. (5 s.h.)

1005 Sanitary Chemistry - A systematic study of laboratory procedures and techniques as applied to water analysis and purification. (3 s.h.)

1008 Instruments and Controls - An applied course in the use, performance, maintenance, and calibration of instruments used in water purification and wastewater treatment systems. (3 s.h.)

INSTITUTION: HUDSON VALLEY COMMUNITY COLLEGE

PROGRAM: Public Health Technology - Environmental Health Option

DEPARTMENT: Engineering Technologies and Industrial Technologies Division

DEGREE: Associate in Applied Science

CONTACT: Dr. Charles Zipprich, Chairperson
Environmental Technology Program
Hudson Valley Community College
Vandenburgh Avenue
Troy, New York 12180
(518) 283-1100

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Hudson Valley Community College is sponsored by the County of Rensselaer under the program of the State University of New York. It is a member of the Middle States Association of Colleges and Secondary Schools. Seven of the College's engineering curricula are accredited by the Engineers Council for Professional Development.

The Public Health Technology - Environmental Health Option is a two-year program designed to educate technicians with a sound foundation in science, mathematics, and environmental engineering. Technicians often perform such tasks as laboratory analysis, sampling, inspections, and operation of treatment plants. With consulting sanitary engineering firms a technician may assist in the design, construction and start-up of water pollution control plants or become involved in comprehensive wastewater studies. Employment opportunities are available as environmental health technicians and sanitarians in city, county and state health departments. Graduates also find employment as chief superintendents and shift operators at municipal and industrial water and wastewater treatment plants. Within industry, positions are available performing laboratory analyses and stack testing.

The College furnishes a laboratory with stack sampling and other similar types of equipment students receive training through courses in water purification, wastewater treatment, air pollution control, limnology, environmental quality, and participate in a two semester environmental seminar.

PROGRAM REQUIREMENTS

In order to enter the program, two years of high school mathematics is required and it is helpful to have taken additional science and mathematics courses. Structured into two year, four semester curriculum are 64 credit hours which include eleven courses not specifically environmental health such as physics, biology, ecology, and microbiology.

The College has developed thirty slide and tape programs on limnology. One of the faculty members works at the Rensselaer County Waste Treatment Plant and thus is able to maintain current with industry needs. The College also conducts continuing education courses for Grade Two water and sewage treatment plant operators.

New York State residents can apply for Tuition Assistnace Program Grants which are based on need and range from $100 to $600 per year. Other grants and loans available include the Basic Education Opportunity Grant, the New York Higher Education Assistance Corporation Loans, Educational Opportunity Grants and so on.

CURRENT FACULTY, STUDENTS, GRADUATES

Two faculty members (one full-time) teach the Environmental Health courses. The Program has a total enrollment of 45 full-time students (fall, 1977) including ten females. Only one additional student attends on a part-time basis. About twenty students annually graduate and receive the A.A.S. degree although it is expected that the number graduating will begin to drop.

Many students decide to continue their education for higher degrees and the College has a transfer agreement with the State University of New York at Plattsburgh to accept Hudson Valley College's students into its B.S. Environmental Studies Program. Others have continued to the Rensselaer Polytechnic Institute, the University of Buffalo, Syracuse University, the University of Alaska and SUNY at Albany's Environmental Science Program. Approximtely one-third of the graduates continue on for higher degrees and it is estimated that fifty to sixty percent of the graudates of the program find employment in their field and about 85% find government jobs. The College has a Placement Office to assist students in their search and referrals are accepted by the program from employers.

COURSE DESCRIPTION

1802 Environmental Quality - Coverage of public health activities with particular reference to environmental sanitation, solid waste disposal, radiological health, and others. Laboratory will emphasize use of radiation monitoring techniques, noise measurements, and field trips to pertinent facilities. (4 s.h.)

1806 Environmental Seminar - This course is designed to give the student an overview of the environmental dilemma facing society. (1 s.h.)

1811 Water Purification - Design and operation of water purification and distribution systems for domestic and industrial installations. (4 s.h.)

1813 Waste Water Treatment - Design and operation of waste water collection, treatment and disposal systems for domestic and industrial installations. (4 s.h.)

1820 Air Pollution Control - An introduction to air pollution control including effects and sources of air pollution, transport and sampling of air pollutants, control equipment. The laboratory consists of sampling and anaylsis of air pollutants. (4 s.h.)

1830 Limnology - A consideration of the physical, chemical and biological characteristics of unpolluted and polluted lakes and streams. The laboratory will consist of extensive sampling and analysis of a lake or stream chosen by the instructor for study. (4 s.h.)

INSTITUTION: MIAMI-DADE COMMUNITY COLLEGE

PROGRAM: Civil Engineering Technology - Environmental Option

DEPARTMENT: Engineering

DEGREE: Associate in Science (A.S.)

CONTACT: Mr. John C. Pistorino, P.E., Chairperson
Department of Engineering
Miami-Dade Community College
South Campus
11011 S.W. 104th Street
Miami, Florida 33176
(305) 596-1225

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Civil Engineering Technology program at Miami-Dade Community College is a two-year curriculum offering basic theory and practices in civil engineering and construction, which prepares students for employment as assistants to engineers and construction supervisors. Along with the environmental option, six other options are offered: general, structural, highway, survey and mapping, engineering construction and traffic engineering. Those in this A.S. program with the environmental option receive special training in water and wastewater treatment processes, including the design, construction, operation, control and management of water and wastewater systems. Graduates are especially qualified to work as technicians with consulting engineers in the design and construction of treatment plants and to be assistants to engineers in environmental regulatory agencies. The program is also designed to encourage and assist students toward obtaining a professional degree such as the B.S. in Civil Engineering Technology offered by Florida International University in Miami.

Department faculty have been very active in the environmental field, and have received a number of grants from the U.S. Environmental Protection Agency and other sources. Other activities in the water and wastewater field have included providing academic training for water and wastewater operators, offering courses for operators and technicians for the National Pollutant Discharge Elimination System (NPDES), developing materials for a standardized EPA NPDES training manual, and assisting the Florida Water and Pollution Control Operators Association with its operator training courses.

PROGRAM REQUIREMENTS

Admission to Miami-Dade Community College is open to all high school graduates, and to all others over eighteen years of age. Students considered difficient in basic skills are referred to the college's Learning Support Service for individualized remedial instruction.

Civil Engineering Technology - Environmental Option consists of sixty-three semester credits, and can be completed in four terms by full-time students. The freshman year is common to all civil engineering technology students, and includes six credits each in English composition and technical mathematics, four credits each of descriptive geometry and elementary surveying, three-credit courses in engineering drawing, and computing and estimating, and two-credit courses in construction management contracting and slide rule. For the environmental option, the sophomore year includes twenty-one credits of civil/environmental engineering courses, as well as four credits of physics and physics laboratory, and six credits of social science. Physical education is required each semester. Students must earn a 2.0 grade point average to be eligible for graduation.

There are no special sources of financial support to students in this program. Any student in the college may apply for scholarships, loans, part-time employment, or a combination; these are awarded based on student requirements.

CURRENT FACULTY, STUDENTS, GRADUATES

Four full-time and one part-time faculty members in the Engineering Department provide teaching and administrative support to the environmental programs, including both the planned certificate and A.S. programs. In most cases, functions of faculty members overlap between these programs. In addition, approximately ten professionals in the field, from local environmental agencies, utilities, and consulting firms, assist in teaching environmental courses on a part-time basis.

There are normally approximately fifty students each term taking environmentally related courses, although the exact number seeking this degree is not known. Approximately twenty-five persons per year graduate with a degree in Civil Engineering Technology. Again, it has not been established how many of these have pursued the envirommental option. Sources do indicate that the great majority of those graduating with this option do find employment in the field, according to available information. Employment choices are estimated to be split nearly equally between consulting firms and environmental regulatory agencies.

PROGRAM PROJECTIONS

Program officials project that the number of students pursuing this option will remain relatively stable over the next several years. The number of faculty will also remain stable unless outside supportive funding is completely terminated. No major program changes are planned.

ADDITIONAL INFORMATION

Department faculty have recently been involved in assessing training needs in other environmental fields for the Dade County area. As a result, new curriculums are being developed and may be implemented on an ongoing basis. Under consideration are programs in the fields of air, pesticides and solid waste.

An air pollution technician training program was recently developed in cooperation with the University of Miami under an EPA grant. This curriculum was developed in anticipation of a statewide automobile testing program, and the state furnished laboratory equipment. The one-semester course has already been held in the laboratory and throughout the state with teaching support from both institutions; these instructors also developed the text. Because the state has not followed through with the automobile testing program, this curriculum is being revised, and will probably become a one-year planned certificate program. Originally, the course contained seventy-nine hours of classroom and laboratory instruction and covered the following topics: mathematics (11 hours), chemistry and physics (6 hours), air pollution (11 hours), meteorological aspects (3 hours), the automobile and air pollution (6 hours), instrumentation and techniques for exhaust gas emission (40 hours), and the expert witness (2 hours).

The planned pesticides program has not received final approval for implementation, but an advisory committee has been established for assistance in curriculum planning and implementation. A tentative curriculum has been developed which consists of sixty-four credits for the A.S. degree in Pest Control Technology. If approved, pesticide applicator training will be provided for entry level and currently employed pest control operators. Students will acquire the ability to identify pest problems, design control programs, use control equipment, be a representative for customer sales and service, and implement safety procedures. It is anticipated that employment opportunities will also be available for students completing one year, or thirty credits, of the program.

The development of objectives and preliminary contact with industry have taken place regarding the proposed solid waste curriculum. This program will probably lead to a certificate and flow into the Civil Engineering Technology curriculum. There may be two levels developed, the first focusing on training the landfill operator (in anticipation of mandatory certification of landfill operators). The second would focus on engineering aspects, and the design of sanitary landfills and other disposal/processing facilities.

COURSE DESCRIPTION

(Civil Engineering Technology Courses Required for the Environmental Option)

CIT 170 Elementary Surveying - The theories and practices of surveying and the use of the principal types of surveying instruments

CIT 170 (Cont'd) - in the horizontal and vertical planes. Field practice. (4 s.h.)

CIT 290 Treatment Operations Processes - Provides the student with the knowledge and skills to understand and perform the routine physical, chemical, and biological operations for control of processes in water and wastewater treatment and other pollution control. (3 s.h.)

CIT 291 Water and Waste Systems - The design, construction, operation, control and management of water collection, purification, and distribution systems. Waste collection, disposal systems, and treatment plants. (3 s.h.)

ROT 272 Engineering Project Planning and Development - An elementary course in project planning and development in highway and other construction which involves feasibility studies, financing, planning, programming, design, and construction. Office engineering techniques are investigated through the solution of problems. Meets the needs of all civil engineering students. (3 s.h.)

ROT 280 Design and Inspection Procedures - The presentation of organizations, policies, procedures, and practices relating to the engineering and construction of highways, buildings, utilities, and other facilities. Utilization of Standard Operating Procedures for design, layout, inspection, and testing. (3 s.h.)

ROT 282 Statics - The application of dead and live loads to rigid bodies at rest, including the force and moment laws of equilibrium, determination of the direction and intensity of reactions, moments and stress in the design of engineering and architectural structures. (3 s.h.)

ROT 283 Computing and Estimating - Approximate and exact methods of computing and estimating quantities from plans; arriving at unit prices, lump sum costs, and estimated total costs from quantities; making preliminary and final estimates. (3 s.h.)

ROT 290 Applied Hydraulics and Drainage Structures - The application of basic hydraulics principles to engineering problems in the collection, distribution, and disposal of water and wastes. Laboratory work solving realistic problems. (3 s.h.)

STT 160 Construction Management and Contracting - The legal, ethical, political, architectural, engineering, and economic implications of contracts and of the procedures for soliciting, estimating, proposing, accepting, administering, and changing lump sum unit price, and cost-plus contracts. (2 s.h.)

STT 170 Construction Materials - The principal materials used in the construction of highways, buildings, utilities, and other structures, including a consideration of the processes for the selection, specifying, testing and preservation of materials. (3 s.h.)

INSTITUTION: MIDDLESEX COUNTY COLLEGE

PROGRAM: Environmental Health Science Technology

DEPARTMENT: Science Division

DEGREE: Associate of Applied Science (A.A.S.)

CONTACT: Diane Trainer, Chemistry Department
Middlesex County College
Edison, New Jersey 08817
(201) 548-6000 extension 241

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Middlesex County College initiated its Environmental Health Science Technology Program in 1971 to train technicians as: laboratory technicians to perform air, water, and wastewater analyses; water and wastewater treatment plant operators, air pollution inspectors; stack samplers; public health enforcement officers (sanitorians and food and drug inspectors); and industrial hygiene technicians. Emphasis is placed to produce graduates with both flexibility and adaptability so they are able to work in more than one pollution control and abatement area.

This two year program stresses environmental laboratory training, and courses are integrated from biology, chemistry, physics, microbiology and other areas. The program offers advantages to students of low tuition, modern equipment and facilities, personalized laboratory supervision, and faculty with teaching and industrial experience.

PROGRAM REQUIREMENTS

In order to enter the Environmental Health Science Program, a prospective student must be a high school graduate, have one year of laboratory science and one year of Algebra. Structured into the two year, four semester curriculum are sixty-four credits of courses which include water and wastewater treatment, environmental microbiology, air pollution control, sanitary chemistry, industrial hygiene, and community sanitation. Six credits of humanities and social science electives must be taken within the present structure.

In the second semester of the second year, the students are employed for one day each week. However, they are not salaried and their primary function is one of observation. One college credit is received for their participation in this internship program. A log is kept by the student of the activities in which they participated and at the end of the period, the students immediate job supervisor writes an evaluation of the student's performance. This internship program has often enabled students to use the evaluations as letters of recommendation when later searching for employment or being offered jobs by their internship employer.

Financial aid from the State of New Jersey is available to students and a few receive work-study funding. Students also have access to other federal programs such as the Educational Opportunity Fund, ROTC, and the Basic Educational Opportunity Grant Programs.

CURRENT FACULTY, STUDENTS, GRADUATES

Four faculty members currently teach concepts of environmental science to students enrolled in the Environmental Health Science Program and all are full-time. The Program currently has an enrollment of 19 students, full-time, and four part-time. Four of the full-time students are female. Since the program was initiated in 1971, there has been a consistent graduating class of fifteen students.

About forty percent of the annual graduates transfer into other college or university environmental programs. Middlesex Environmental Health Science graduates often attend Bachelor degree programs offered by Rutgers, Stockton State College, Ramapo State College, New Jersey Institute of Tehcnology, Michigan Tech, and San Jose State College. The College maintains a placement service and a job counselling service to assist students in their employment search. Program officials estimate that of ten total graduates, six find employment and four are college transfers. Of seven 1976 graduates surveyed by the College in 1976, six found employment in their field and one in a related field. Only one of the seven found employment with a governmental agency.

PROGRAM PROJECTIONS

Although College officials project that environmental programs are continuing to increase in number and size, the emphasis is mainly in specific areas, e.g. industrial hygiene, energy, and water. There are no current plans being made by College officials to expand the Environmental Health Science Technology Program because no real need exists at present. However, due to an increased enrollment, one additional faculty member will be recruited in 1978 to teach environmental science and chemistry courses.

COURSE DESCRIPTION

ENV 201 Advanced Wastewater I - Covers such topics as wastewater characteristics, flow measuring devices, physical treatment systems, and sludge digestion and disposal. (3 s.h.)

ENV 202 Advanced Wastewater II - Covers an approach to total treatment of wastewater. Prepares a student for the NJ State Wastewater Operators License. (3 s.h.)

ENV 203 Advanced Water Operations I - Sources of water and their characteristics, water cycle balance, reservoirs in NJ, surface and ground water supplies, methods of analysis, disinfection, tastes, and odors. (3 s.h.)

ENV 204 Advanced Water Operations II - Water treatment operations including pretreatment and filtration, distribution systems, records, budgeting, and supervision. ENV 203 and 204 must be taken to prepare a student for the NJ State Water Operators License. (3 s.h.)

ENV 205 Atmospheric Pollution - Community air pollution, stressing problems and the technology used for their detection and control. (3 s.h.)

ENV 207 Concepts of Environmental Science - A one-semester course for the career-oriented student that explores the possible causes and cures of all types of pollution in our society. (3 s.h.)

ENV 208 Community Sanitation - A survey of current community and environmental health problems with emphasis on communicable diseases, waste disposal, water and air pollution control, food sanitation and radiological health, and other topics. (3 s.h.)

ENV 211 Environmental Science I - Emphasis is on the water and air environment. Includes laboratory and field trips. (4 s.h.)

ENV 212 Environmental Science II - Focuses on solid wastes, noise, energy, radiation, and other miscellaneous environmental areas of concern. (4 s.h.)

ENV 222 Water and Wastewater Analysis - A systematic study of laboratory procedures as applied to water analysis and purification. (3 s.h.)

ENV 250 Environmental Internship - One day per week exposure to an environmental career. (1 s.h.)

ENV 220 Industrial Hygiene - This course examines the sampling and analytical techniques required to evaluate the safety and health hazards associated with the industrial environment. (3 s.h.)

INSTITUTION: MUSKINGUM AREA TECHNICAL COLLEGE (MATC)

PROGRAM: Environmental Quality Control Technology

DEPARTMENT: Division of Engineering and Science

DEGREE: Associate of Applied Science (A.A.S.)

CONTACT: Mr. Charles M. Woolf, Division Chairman
Division of Engineering and Science
Muskingum Area Technical College
1555 Newark Road
Zanesville, Ohio 43701
(614) 454-2501

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Environmental Quality Control Technology program offered at Muskingum Area Technical College is designed to train paraprofessionals to meet manpower needs necessitated by stricter legislation and enforcement of environmental quality standards. Graduates receive an Associate of Applied Science degree preparing them to work with professional biologists, chemists, engineers, and environmentalists in conducting air and water quality studies. Their work includes the collection and analysis of air and water samples for routine monitoring, special studies, and for insuring compliance with environmental quality laws.

During the second-year of this two-year program, students may choose two technical electives that provide them with a more intensive training in either air or water quality. However, students are now encouraged to take the technical electives under both options; and all students currently enrolled do so. All other coursework for the two options is identical. The college maintains analytic and mobile laboratories for each option area all equipped with a broad spectrum of instrumentation. The air laboratories permit meteorological and air sampling tests while the water quality labs allow water testing. Students learn to maintain and operate all of the equipment in these laboratories (10 to 15 percent of the equipment was donated by the Environmental Protection Agency. The meteorological recording station is the only one in a five-county area. Nearby industries cooperate in on-site visits by students to their facilities.

Environmental Quality Control Technology faculty have conducted workshops for the Ohio Environmental Protection Agency in the area of particulate analysis (air and for high school students and and teachers on more general topics. State certification in microbiological particulate analysis is almost complete, and work toward certification in inorganic analysis will begin soon. As a service to public agencies, the program also sponsors a testing lab for the National Pollution Discharge Elimination System (NPDES) which gives students experience while in school for jobs upon graduation.

Curriculum oversight is provided by an advisory committee of local citizens in the environmental quality field. All students intern during the summer months in some form of employment related to their particular technological interests and receive college credits for this work. The environmental program presently has a special intern on-the-job arrangement with the City of Zanesville for outstanding students.

PROGRAM REQUIREMENTS

To obtain the Associate of Applied Science in either Air or Water Quality, the student must complete 110 quarter hours in basic sciences, mathematics, communication, social sciences, and, of course, environmental sciences. Admission to MATC requires a high school diploma or its equivalent.

CURRENT FACULTY, STUDENTS, GRADUATES

Two faculty members serve the 23 first-year and 13 second-year students currently enrolled in the program. The statistics on program graduates (six in 1976, nine in 1977) indicate an increasing number of students who are completing this course of study. Financial assistance consists of standard programs such as Basic Educational Opportunity Grants, Ohio Instructional Grants, College Work-Study, National Direct Student Loan, Supplemental Educational Opportunity Grants, and Ohio Student Loans.

On the average, over two-thirds of the Environmental Quality Control graduates gain employment in their technological field. There are no reported problems with placement though the faculty note that available positions in municipalities, consulting firms, industry, and the Environmental Protection Agency are limited to those requiring two-year graduates. The college cannot fill all the water and wastewater jobs listed at MATC. Employment opportunities come through the college placement office (each technology has its own placement officer), the student's internship experience, and the program's advisory committee. Jobs are available to graduates of this program in public health departments, pollution control equipment manufacturing, municipal water and wastewater treatment facilities, federal and state fish and wildlife departments, U.S. Corps of Engineers, private consulting firms, research laboratories, private industries, federal and state Environmental Protection Agency offices, and local environmental control boards.

PROGRAM PROJECTIONS

The faculty of the Environmental Quality Control department predict a stable future for their program. Depending on decisions by the Environmental Protection Agency and changing career opportunities, the program may shift toward more water-related courses (water distribution, wastewater, etc.). An additional staff member in biology will have to be hired in the next five years to meet enrollment demands.

A major concern of the staff at MATC is the lack of employer awareness of the capabilities of the two-year technician who has both practical skills and theoretical knowledge. Staff personnel contend that public support, training monies for students and workshops, and increased enrollments are essential in order to maintain the current environmental programs in the State of Ohio.

COURSE DESCRIPTION *

BIOL 141 Field Zoology and Ecology - A study of the animals common to this area, stressing identification and the environmental aspects which affect their distribution. The basic principles of ecology are covered with emphasis on the interrelationships between an animal and his physical and biological surroundings. (3 q.h.)

ENV 111 Industrial Processing and Pollution Control I - Prime emphasis will be the study of major manufacturing and industrial processes and products with orientation towards the origins of the pollutants and the engineering problems involved in their control. Each industry's air, water, and solid waste problems will be studied from the industrial engineer's viewpoint with emphasis on a total solution. (3 q.h.)

ENV 151 Introduction to Environmental Quality Problems - An introduction to environmental pollution, its effects on man, other animals, and plants. It includes discussion of the major pollution sources, and health and economic problems created by pollutants. (3 q.h.)

ENV 135 Earth Science - A study of the physical principles guiding the earth's development, including basic geology, weathering and land forms; the method of locating points on the earth and principles of mapping; principles of meteorology; interactions of abiotic and biotic components of the environment. (3 q.h.)

ENV 112 Industrial Processing and Pollution Control II - This is a continuation of ENV 111 looking at major industries and their unique problems associated with pollution control. (3 q.h.)

CHEM 111 Chemistry--Basic and Organic - designed to introduce the students to the basic principles of chemistry, atomic theory, CHEM 111 (Cont'd) - chemical bonding, reactions, and other aspects of preparatory chemistry. This course specifically meets the needs of field analysis and laboratory in environmental quality control. It will include studies of organic compounds as pollutant compounds. Laboratories will include testing techniques specific to environmental quality control. (4 q.h.)

ENV 121 Air Sampling and Analysis - A study of the standard techniques of ambient air sampling. This course shall include an understanding of the principles of operation and maintenance of air sampling equipment; an understanding of the analytical (quantitative and qualitative) techniques used to identify and measure air pollutants; experience in site selection and in collection of various types of air samples; practical experience in laboratory analysis of air samples by the standard methods of wet chemistry, colorimetric method, and instrumental analysis; and the interpretation of data collected and analyzed by the students. (4 q.h.)

ENV 171 Water Sampling and Analysis - The course is designed to give practice in water sampling techniques and chemical analysis (wet chemistry, instrumental analysis, and by portable test kits) of the water quality of streams and lakes. It also includes studies of new methods, techniques, instruments in field sampling and laboratory analysis, data interpretation, and reporting results. (4 q.h.)

ENV 251 Environmental Quality Laws and Enforcement - An analysis of existing environmental quality control laws, methods of establishment, and the enforcement practices of the different governmental agencies. (3 q.h.)

NS 200 Internship - Supervised work experience required for environmental sciences students. Includes student applying for job in related area, on-the-job supervision, scheduled visits by coordinators, and periodic evaluations. (7 q.h.)

NS 299 Seminar - Course taken in conjunction with Internship. Includes discussion of students' intern experiences, principles of employment practices, and improvement of employee traits. (3 q.h.)

ENV 271 Environmental Instrumentation - An introduction to the types of measuring means and their function, their operation, practical construction, and uses. Instrumentation terminology and measuring devices for temperature, flow rates, level control, pressure, other control devices, monitoring, and recording instruments are studied. (4 q.h.)

ENV 291 Water Treatment Techniques - The course is designed to provide the formal training to allow the student to attempt the State of Ohio Class One Operator Water Exam. The course will emphasize sources, water softening, water hygiene and

ENV 291 (Cont'd) - public health aspects, distribution systems, types of equipment and treatments, and budgetry. (4 q.h.)

ENV 235 Environmental Science Computer Applications - Introduction to computing sciences for the analysis and interpretation of environmental data and computer print-out. Simple statistical treatment of data is combined with the utilization of simple calculators, programmable calculators, the PDP-8 terminal computer, and the IBM 360-30 computer. Simple programming is combined with other computer operations such as keypunching and sorting, and the use of pre-programmed packages. (3 q.h.)

ENV 281 Environmental Health - An investigation into the activities of the state and local health departments including their role in setting environmental standards and methods of inspection for water, wastewater treatment facilities, air quality monitoring, insect vector and rodent control, pesticide use, radiation safety, milk and food service, and communicable disease control. (4 q.h.)

ENV 211 Emission Control Techniques - A study of industrial and vehicular emissions, presenting the fundamental principles of gravitational settling, inertia, filtration, absorption, and combustion applicable to control of various pollutants at their sources with odor and noise control. (3 q.h.)

BIOL 151 Field Botany and Ecology - A study of the structure and life processes of plants, the classification and identification of plants, and the basic principles of plant ecology stressing the environmental affects on the morphology, physiology, and distribution of plants. (3 q.h.)

ENV 215 Wastewater Treatment Techniques - The course is designed to provide the training to permit the student to apply for the State of Ohio Class One Operator Wastewater Exam. The course will emphasize types of treatment and equipment, wastewater hygiene and public health aspects, sewer systems, and budgetry considerations. (4 q.h.)

ENV 225 Stack Gas Sampling and Analysis - The course stresses the basic techniques in source sampling at the stack and the specific analytical techniques required. It also includes the areas of monitor design, isokinetic techniques, and continued vs. periodic sampling techniques. Experiences are gained through practical lab and field work. (3 q.h.)

Technical Electives - Air Option:

ENV 285 Blueprint Interpretation - An introduction to the theory of projection and dimensioning as related to working drawings and blueprints. Development of ability to interpret shape, ENV 285 (Cont'd) - size, position, and functional relationships of structures and mechanisms from blueprints. (3 q.h.)

EE 251 Introduction to Electricity/Electronics - A study of the fundamentals of the science, the how and why circuits behave as they do and their relationship to common devices. Provides an introduction to electricity/electronics. (3 q.h.)

Technical Electives - Water Option:

ENV 265 Microbiological Techniques - The basic techniques in culturing and identifying microorganisms, with emphasis on the bacteriological techniques used in water quality analysis and the environmental health field. (3 q.h.)

ENV 275 Aquatic Organisms - Identification and classification of common aquatic life from microorganisms to vascular plants and vertebrates; ecological relationships, environmental needs and responses to change, and the use of diversity index and indicator species. (3 q.h.)

* courses are listed in the sequence taken by the student

INSTITUTION: NORTHERN MONTANA COLLEGE

PROGRAM: Environmental Health Technology

DEPARTMENT: Science

DEGREE: Associate Degree (A.D.) in Environmental Health Technology: Water and Wastewater Treatment

CONTACT: Mrs. Martha Dow
Director, Environmental Health Technology
Northern Montana College
Havre, Montana 59501
(406) 265-7821

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental health technology: water and wastewater treatment program was instituted at Northern Montana College in September, 1976. The curriculum provides the student with a braod base in general education, mathematics and science. The major emphasis, however, is on water and watewater treatment. Certification as a water and/or wastewater treatment plant operator, as well as continuing education, are the stated goals of this two year program.

The guidelines for curriculum content and sequence were developed by the U.S. Environmental Protection Agency and the Montana State Department of Health.

The majority of the students associated with this program will become employed by municipal water and wastewater treatment plants. Occupational opportunities exist, however, within industry.

PROGRAM REQUIREMENTS

Admission to the environmental health program is accomplished by applying directly to the director at Northern Montana College.

A total of 96 quarter hours is required for the Associate Degree in environmental health technology. The course work may be completed within six quarters or two academic years. The following course work is required, usually at the first year: 11-12 quarter hours of communications, technical writing and general education electives; 19 quarter hours of biology, chemistry, botany and microbiology; 10 quarter hours of mathematics; and six quarter hours of environmental health (SB 110 and 120).

The second course requirements include the following: 17 quarter hours of physics (PS 209) invertebrate zoology, conservation and ecology; five quarter hours of general education; five quarter hours of environmental microbiology (SB 218); and, 19 quarter hours (once each quarter) of special topics for water and wastewater treatment plant operators. The last requirement presents specific practical topics of interest to future treatment plant operators as they study for the operator's certification examination.

A six month internship is required for successful completion of the program. Entitled topic studies and field experience (SB 211/212), the students spend both summers under the supervision of the faculty completing individual projects and on-the-job training in a plant. The Department of Health personnel and some certified plant operators assist with both facets of the internship program. The highlight and strength of the program rest with the internship commitment. This is a most time consuming aspect of the training, as faculty members must initiate the interest and cooperation on the part of local treatment plant personnel.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty consist of six full-time personnel, three of which hold the doctoral degree and three others have master's degrees. In conjunction with the program, there are part-time personnel, including lecturers and treatment plant operators, who assist the regular faculty with instruction.

At present there are 19 full-time students of which 17 are male and two are female. The first year of the program (1976-77) the students were from treatment plants or students who changed majors to enter the new program. This year, however, 10 new students entered the program directly from high school. There have been no graduates of the program as yet. The first students to graduate from the program will receive the Associate Degree at the end of the fall quarter, 1978.

PROGRAM PROJECTIONS

Program personnel anticipate growth and expansion in this new program over the next three to five years. The occupational thrust of the program is an area which faculty and staff wish to expand upon.

Northern Montana College recently received a grant from the U.S. Environmental Protection Agency to train and/or upgrade potable water treatment and supply personnel. This coming year the college will host several on-campus short courses and workshops for water and wastewater related operators. Undoubtedly, these activities will increase as the program develops.

COURSE DESCRIPTION

SB 105 Foundations of Biological Science - Introduction to basic principles of biology. (5 q.h.)

SB 110 Introduction to Environmental Health - An orientation to the field of environmental health. This course would include a survey of the topics of environmental protection, food and water quality, living and working environments, and pollution control. Qualified

SB 110 (cont'd) - consultants from the Department of Health and the professions involved would serve as resource people and guest lecturers. (3 q.h.)

SB 120 Environmental Health Practices - A practical field study course in water sampling techniques, sewage disposal facility operations, practices of water purification and wastewater monitoring. The course would include collection of data and inspection methods to evaluate current federal and state regulations for pollution control. (3 q.h.)

SB 217 Microbiology - A survey of the microbial world including bacteria, viruses, rickettsiae, protozoa and algae; relationships of microorganisms to man and the environment including health and disease, sanitation and industry; laboratory work will demonstrate study techniques, cultivation, isolation, microbial activities, with emphasis on antisepsis and medical microbiology for students entering health related fields. (5 q.h.)

SB 218 Environmental Microbiology - Practical and applied microbiology as related to water quality, food sanitation, wastewater treatment, solid waste management, and pollution controls. (5 q.h.)

SB 314 General Ecology - Integrated principles of ecology involved in terrestrial and aquatic ecosystem studies. (5 q.h.)

INSTITUTION: SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

PROGRAM: Environmental Technology
DEPARTMENT: Environmental Technology
DEGREE: Associate in Science

CONTACT: John T. Donohue, Chairman
Division of Engineering Technologies
Springfield Technical Community College
Armory Square
Springfield, Massachusetts 01105

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This two-year Environmental Technology Program integrates two technical environmental options: Quality Technology, and Wastewater Treatment Technology. Formerly, these two options had separate curriculum structures but now are offered in one curriculum. The orientation is toward environmental engineering with the goal of training students to become para-professionals to assist an engineer. Their functions would include detecting and measuring pollution, installing control facilities, and operating purification facilities. It is anticipated that graduates would qualify for positions in industrial facilities, governmental agencies, municipal engineering offices, engineering firms; waste treatment plants and manufacturers representatives. This career-orientated program has not been designed to enable a student to transfer to a four-year college program. Springfield Technical Community College is an accredited member of the New England Association of Schools and Colleges.

The Department of Environmental Technology offers extensive facilities to assist students in receiving "hands-on" instruction. The program utilizes a complete chemical laboratory, a small model of an activated sludge filtration system, and air and water sampling equipment. Water samples are also picked up by the department from the Springfield waste treatment facility for analysis by students in the laboratory. In addition the program emphasizes its summer practicum between the first and second year in which students work forty hours a week for five weeks at treatment facilities (12 to 15) located within a 75 mile radius of the college.

PROGRAM REQUIREMENTS

In order to be considered for admission into the Environmental Technology Programs, prospective students must have had one year of chemistry and two years of algebra or its equivalent. Structured into the four semester curriculum (including the summer practicum) are sixty-eight credit hours of requirements. Included are courses covering the topics of process problems, environmental microbiology, technical report writing, treatment plant operations, industrial health and safety, water sample, analysis and control processes, systems maintenance, and air sample, analysis and control processes.

Most of the forms of financial aid available to students consist of the Basic Educational Opportunity Grant Program and Work-Study. Limited amounts are available from other funding sources.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members contribute to the Environmental Control Technology Program of instruction. Currently (fall, 1977) the program has an enrollment consisting of twenty-six full-time male students, and approximately 10 students graduate annually on an average. Enrollment appears to be slowly increasing over the past few years.

Although this program is designed to be terminal, about eight to ten percent of the graduates continue on for higher education, although most find employment as waste treatment plant operators. For example, some of the program's graduates have changed their original career objectives midway through completion of the program and are enrolled in a general environmental science program (bachelor's) offered by the University of Maine. Although the college assists students in their employment search through its placement office, students often have more success securing jobs through participation in the summer practicum and responding to employers inquiries made to the department. Program officials estimate that 95% of the graduates obtain employment in their field and 5% in a related field Although most (80%) find government jobs, some students (20%) find jobs in the private sector, mostly in paper mills.

PROGRAM PROJECTIONS

The Environmental Technology Department is not anticipating hiring additional faculty members over the next five years as the program can accomodate more students with present staff. The program is flexible enough in orientation to be able to adapt to changing needs but current emphasis is on the development of the program's current resources.

The need to train wastewater treatment plant operators is expected to continue to increase although the need will begin to level off once the plants are built. However, department contacts do not anticipate that they are anywhere near a saturation point in the near future.

COURSE DESCRIPTION

6183 Wastewater Sample and Process - An investigation of the chemistry of domestic and industrial liquid wastes, their effects upon wastewater treatment plants and processes and the test procedures and techniques required for treatment plant operation. (3 s.h.)

6186 Environmental Studies - An introduction to environmental pollution, its effect on man and other living things and the basic principles of sanitation, treatment and control. (3 s.h.)

6190 Systems Operations and Maintenance - A study of wastewater treatment plant equipment with emphasis on diagnosis and repair and preventive maintenance programs. (3 s.h.)

6192 Treatment Plant Unit Operations I - An investigation of the physical and chemical processes utilized in the treatment of liquid wastes. (3 s.h.)

6197 Air and Water Quality Control Processes - A study of the processes utilized to reduce or eliminate pollution of the atmosphere. (3 s.h.)

6200 Air and Water Sampling and Analysis - An investigation of the equipment and techniques used in atmospheric sampling and of the instruments used to analyze the samples. (3 s.h.)

6201 Industrial Health and Safety - An investigation of the procedures and attitudes required so that man may safely work in the vicinity of industrial processes and equipment. (3 s.h.)

6234 Basic Instrumentation - A study of electrical, electronic and pneumatic basic and operating principles as applied to instrumentation used for the measurement and control of process variables. (3 s.h.)

6328 Treatment Plant Unit Operations II - An investigation of the physical and chemical processes utilized in the treatment of liquid wastes. (3 s.h.)

INSTITUTION: SUMTER AREA TECHNICAL COLLEGE

PROGRAM: Environmental Engineering Technology

DEPARTMENT: Environmental Engineering

DEGREE: Associate in Engineering Technology (A.E.T.)

CONTACT:
Mr. Robert C. Chen
Head of Environmental Engineering
Technical Division
Sumter Area Technical College
506 Guignard Drive
Sumter, South Carolina 29150
(803) 773-9371

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This two-year program in environmental engineering is accredited by the Engineers' Council for Professional Development (ECPD), and was implemented in 1968. Courses currently focus on potable water, wastewater, air pollution, and solid waste disposal; however, the environmental fields of pesticides, noise, and radiation receive limited coverage. Inquiries concerning this program have been received from institutions all over the world.

Graduates of this program should have the knowledge of principles and laboratory procedures necessary to perform tests on liquid and solid wastes, water, and foods to determine their suitability for release into the environment. They are considered qualified to enter such positions as industrial waste technician, municipal water and sewage treatment plant operator, and water pollution control and sanitary technician. Graduates may also find employment as technical sales and service personnel for equipment and chemical companies, and as engineering technicians with governmental and private organizations. Officials believe that in many respects, graduates of this program serve industries and municipalities better than graduates of four-year programs.

The faculty of this program have participated in offering NPDES training to operators of wastewater treatment plants, in cooperation with state and federal agencies, and have carried out non-sponsored training courses for plant operators. The ECPD has rated the laboratory facilities available to the program's students and faculty as "exceptional".

PROGRAM REQUIREMENTS

High school graduation or the equivalent is required for entrance into the college. Students deficient in crucial areas, as determined by SAT or ACT scores, are referred to the school's learning laboratory for special instruction.

The environmental engineering technology program consists of 105 quarter hours of credit. Twenty-four of these credits are required in general education, while forty-three are in the major field. An additional twenty-three hours are required in the areas of biology, chemistry, engineering, and analytical geometry and calculus. Fifteen hours of electives may be chosen from a selection of eight courses in the areas of civil engineering, drafting, mathematics and physics.

Several field trips are included in each student's curriculum. Seniors must carry out research-related projects under the supervision of an instructor. The environmental engineering faculty is seeking to cooperate with the City of Sumter in offering an internship program. As anticipated, each student will spend one quarter (summer quarter) working for the city in an environmental field for pay.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members are responsible for teaching the environmental engineering courses, and twenty-eight students are currently enrolled in the program. Only 40 to 50 percent of each freshman class typically reaches graduation in this field because of the program's difficulty.

The number of annual graduates has decreased since the program's inception. This fact is attributed in part to the trend for students not to be willing to invest full effort into the curriculum, and to the low pay scales within the wastewater treatment industry. Laboratory classes are of necessity scheduled during the afternoon, and students are often unable to hold jobs while in this curriculum.

The faculty attempts to keep track of graduates with follow-up letters. The response rate, however, is quite low. From available information, it appears that nearly all graduates have been able to secure employment in the environmental field, mainly in water and wastewater treatment. An estimated 20 percent are now employed with industries, while most of the remainder are with municipalities. Several are employed with state agencies, and a number have opted to continue their schooling.

PROGRAM PROJECTIONS

Officials of the environmental engineering technology program would like to expand upon the areas of radiation control and pesticides in the curriculum, and add the area of energy. If plans are carried through, students in the environmental engineering curriculum would be able to concentrate in potable water, wastewater, air pollution control, radiation control, pesticides, noise control, solid waste, or energy. All students would continue to receive broad environmental training, and would be qualified for a variety of positions.

Because many students are not willing to invest two years into this difficult curriculum, officials are also anticipating developing a one-year program to train environmental control assistants in the areas of water and wastewater plant operations, water and wastewater laboratory, solid waste disposal and/or for field work in state and local health departments. An initial enrollment of twelve to fifteen students is expected, based upon preliminary industrial surveys, with a gradual increase to twenty. A diploma would be awarded upon completion of this program and students would be able to transfer to the two-year environmental program.

In order to implement this program, additional faculty would be required, one for the fields of energy and radiation control, and one for the one-year water and wastewater program. To expand upon the field of pesticides, the department will cooperate with the Agricultural Department of the college.

ADDITIONAL INFORMATION

Instructors of this program have expressed that adequate curriculum materials in the environmental field are not available for two-year programs; most of the materials that are available are overly technical for this level.

COURSE DESCRIPTION

EVT 100 Introduction to Environmental Technology - Major sources of pollution and methods of control. Topics include water pollution, solid waste, air pollution and noise abatement. Field trips to wastewater plants. (3 q.h.)

EVT 212 Water Supply Engineering - The planning of water systems. Population predictions, water, water sources, design of collection and distribution systems, water quality criteria, principles of water purification. (4 q.h.)

EVT 214 Elements of Sanitation - Disease transmission and control; epidemiology; rural water supply and waste disposal; insect and rodent control; solid waste collection and disposal; milk and food sanitation; swimming pool sanitation; industrial hygiene and toxicology; administration of public health. (3 q.h.)

EVT 215 Environmental Chemical Analysis I - The study of water chemistry. Principles and laboratory techniques for control tests of water purification and interpretation of analysis results. (4 q.h.)

EVT 221 Air Pollution Control - Principles of air pollutants control; their classification, dispersion, and control methods. (3 q.h.)

EVT 223 Solid Waste Disposal - The problems involved with solid waste and solid waste disposal. Sanitary landfill and incineration, with emphasis on design and operation. Future solid waste problems and processing. (3 q.h.)

EVT 224 Wastewater Engineering - The principles of wastewater collection and treatment systems, the design of sanitary and storm sewers, and the chemical, physical, and biological characteristics of wastewater and the treatment principle. (4 q.h.)

EVT 225 Environmental Chemical Analysis II - The principles and laboratory techniques for control tests of wastewater treatment such as BOD, COD tests, laboratory formulation of the BOD and NOD curve, determination of K value of BOD reaction, etc. (4 q.h.)

EVT 226 Biological Environmental Engineering - The fundamental microbiology and biochemistry of the microorganisms of importance to the sanitary engineer and interpretation of their relationship to the various designs which interest the sanitary engineer. Designs include trickling filter, activated sludge, and oxidation pond methods. (4 q.h.)

EVT 231 Stream Quality Control - The study of stream pollution and its control. Topics include principles and control of organic pollution and self-purification, mathematical formulation of oxygen sag curve, nutritional pollution and entrophication, microbial pollution, persistent chemical pollution, inorganic salts and thermal pollution. (3 q.h.)

EVT 232 Industrial Waste - Principles of industrial waste pollution and treatability study. (4 q.h.)

EVT 233 Water Quality Engineering - Principles and applications of chemical, physical, and biological methods of water quality control. Emphasis on newly developed treatment processes such as nitrification and dentrification, absorption, filtration, ion-exchange, membrane processes, chemical oxidation, disinfection, corrosion control and sludge treatment. A report required on some aspect of the treatment process. (4 q.h.)

INSTITUTION: TEXAS STATE TECHNICAL INSTITUTE

PROGRAM: Water and Wastewater Technology

DEPARTMENT: Water and Wastewater Technology

DEGREE: Associate of Applied Science (A.A.S.),
Water and Wastewater Technology

CONTACT: Dr. John K. Bird
Chairman
Water and Wastewater Technology
Texas State Technical Institute
Waco, Texas 76705
(817) 799-3611

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The water and wastewater technology program was instituted at Texas State Technical Institute in 1966. This program was established for the benefit of those persons desirous of obtaining the skills and knowledge necessary to make impure water safe for drinking and other purposes. Students of this program learn to define, analyze and solve problems related to potable water systems and to wastewater systems. Students also must take the operator certification examination which is administered by the Texas State Health Department. As the technology of water and wastewater treatment becomes more advanced, so too, do the requirements for those operating personnel. Therefore, in response to the needs of the people of the State of Texas this program was established.

Achievement of the water and wastewater technology degree is a two-year commitment on the part of the students. Since Texas State Technical Institute is on the quarter system, this involves six quarters of classroom and laboratory study. The program leads to the Associate of Applied Science degree.

PROGRAM REQUIREMENTS

Requirements for the first year of this program include successful completion of the following: two courses in chemistry, one course in mathematics and one course in basic drafting; and, 10 courses in water and wastewater technology. During the second year, the student must complete the advanced requirements which include: two courses in communication; two courses in mathematics; two courses in chemistry; one course in construction; and four water and wastewater technology courses. In addition, the students are allowed approved electives during the third, fourth, fifth and sixth quarters.

Students utilize the campus water treatment plant for research and instructional purposes. During the summer quarters, students work in the plant in fulfillment of an internship plan. Upon completion of the course work and the practical on-the-job training, the students are administered the operator certification examination.

CURRENT FACULTY, STUDENTS, GRADUATES

The current full-time teaching faculty with responsibilities for the water and wastewater technology program, consists of two personnel. Both are cost-centered.

At the present time, student enrollment in this program totals 49 full-time students and two part-time students. Of the 49 full-time, there are 43 male and six female students. The two part-time students are male.

The average number of graduates over the last three years, has been 11 annually. In addition, three students, on the average, receive only the certificate. Approximately 10% of the 11 graduates elect to continue their educational studies to the baccalaureate level. Of those students choosing the career path, 63% enter private sector employment and 37% enter public sector employment. All known graduates accept employment in their field.

PROGRAM PROJECTIONS

The water and wastewater technology program is expected to grow over the next few years. The occupational demand is present in Texas, and the program graduates competent, certified graduates.

Within three years, the Institute administration anticipates that two faculty members will be added to the water and wastewater technology program. The Institute is also planning the development of new course offerings.

COURSE DESCRIPTION

WUT 100 Introduction to Water Utilities - Job entry specifications and occupational opportunities in the field of Water and Wastewater. (1 q.h.)

WUT 102 Surface Water Production - Understanding of water resources and conservation. (3 q.h.)

WUT 104 Ground Water Production - Geology and hydraulics of ground water supplied, well production yields, maintenance, and well field concepts. (3 q.h.)

WUT 106 Utilities Calculations I - This course parallels and supports WUT 102 to provide practice in calculations. (2 q.h.)

WUT 108 Water Laboratory Methods - Laboratory procedures that pertain to the quality control of water. (1 q.h.)

WUT 110 Bacteriology of Water - Bacteriology of water with regard to the potability of public water supplies. (4 q.h.)

WUT 112 Wastewater Treatment Plants - Pollution control facility analysis with emphasis on primary treatment, extended aeration trickling filter operation, activated sludge, and other conventional processes. (5 q.h.)

WUT 114 Solids Treatment and Disposal - Aerobic digesters, anaerobic digesters, sludge concentration. (3 q.h.)

WUT 116 Water Distribution and Wastewater Collection - General construction and maintenance practices. (2 q.h.)

WUT 118 Utilities Calculations II - Calculations peculiar to water treatment and wastewater. (2 q.h.)

WUT 120 Utilities Management - Sound practices in project and service costs, rate structures, municipal finance, safety programs and personnel practices are to be taught. (3 q.h.)

WUT 202 Applied Water and Wastewater Chemistry - Water utilities laboratory examination primarily oriented toward wet chemical methods. (5 q.h.)

WUT 302 Applied Hydraulics - A study of the basic concepts of hydrostatics, fluid mechanics, metering devices, pressure control and flow rate controllers, as well as principles of pump operation. (4 q.h.)

WUT 306 Industrial Wastewater Treatment - Special treatment methods for industrial wastes. (4 q.h.)

WUT 308 Seminar - Presentations by students and guest lecturers on subjects of special interest. (1 q.h.)

WUT 402 Advanced Waste Treatment Methods - Innovative methods of wastewater treatment. (4 q.h.)

WUT 404 Advanced Waste Treatment Procedures - Procedures for determination of toxicity factors and reaction kinetics in wastewater treatment processes. (4 q.h.)

INSTITUTION: ULSTER COUNTY COMMUNITY COLLEGE

PROGRAM: Water Quality Monitoring Training
DEPARTMENT: Science Laboratory Technology
DEGREE: Associate in Applied Science

CONTACT: Professor Richard B. Glazer
Project Director and Coordinator of Water
Management Program
Ulster County Community College
Stone Ridge, N.Y. 12484
(904) 687-7621

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Ulster County Community College is currently operating a pilot program to serve as a natural standard for training water quality technicians. The College was selected jointly by the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation to produce this pilot program. Actual instruction of students began in 1975 and the first class graduated in the spring, 1977. The intent is to train technicians to monitor for the National Pollutant Discharge Elimination System and the Safe Drinking Water Act. Water quality monitors completing the program are quality regulatory agencies.

Program graduates obtain employment with government regulatory agencies, municipalities, and engineering and planning firms. They serve in the following capacities: water pollution control facility operators; water treatment plant operators; environmental technicians; sanitation technicians; laboratory technicians; Safe Drinking Water Act Pollution Control Facility Operators; and stream surveillance personnel.

The Water Quality Monitoring Training Program utilizes two laboratories (a third is under construction) and two classrooms. Ulster County Community College staff have also developed a two year *Water Quality Monitoring Curriculum* in September, 1975 and a second volume, *The Learners Guide to Water Quality Monitoring*. Both publications have been published jointly with the U.S. EPA and included in the Water Quality Instructional Resources Information System (IRIS).

PROGRAM REQUIREMENTS

Twenty students are selected each year for admission to this program. Tuition, books, and fees are paid in full by a grant from the U.S. EPA. Approximately five of the students are from Ulster County, five from other areas of New York State, and ten are from states adjoining New York State. Students selected for this training program only have to pay for their own room and board. Criteria for selection of students to participate are individual achievement, personal recommendations and geographical distribution.

Structured in the two year training curriculum are sixty-seven semester hours of credit over a four semester period. General requirements include twenty-seven hours of general chemistry, technical writing, English, elementary statistics and other related courses. Students also can elect six semester hours of humanities electives.

During the summer semester between the first and second years, ENV 104 students participate in a Water Quality Laboratory Experience for three semester hours of credit. Students work in a laboratory associated with a wastewater treatment plant and perform wastewater analysis and collect samples. While working in this cooperative education program with the New York State Department of Parks and Recreation, they are the monitors responsible for ensuring the Parks and Recreation's compliance with Public Law 92-500. The students assist in the training of technicians, setting up laboratories and recommending the necessary equipment that state parks must have to continue monitoring. Their duties include monitoring drinking water plants, stream studies surveillance, baseline studies, and filling in necessary forms.

Other financial aid for students in addition to the training program grant are the Basic Educational Opportunity Program, the New Yrok State Tuition Assistance Program, loans, and employment available through the College Financial Aid Office.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time instructors are currently teaching the Water Management courses. Included in the training program grant are consulting fees to enable professionals to come to the College to lecture.

There are a total of forty-one students currently enrolled in the Water Quality Monitoring Training Program. Of the total, 5 are female, and 8 part-time students are presently enrolled. The first graduating class completed the training program in June, 1977 and there were seventeen graduates. Some students take additional courses at their own expense to complete the program.

Ulster County Community College is currently developing a cooperative program with the University of Maryland, Clemson University, and various SUNY Colleges which would accept Ulster County Community College graduates as transfers into their Bachelor of Engineering Technology Programs. At present, SUNY at Plattsburg is accepting transfers from Ulster into their baccalaureate program in environmental science.

Of the seventeen graduates of the Class of 1977, eight were transfer students. They entered into programs sponsored by Clarkson College, the University of Rhode Island, SUNY at Binghamton, and the University of Connecticut. Most graduates not transferring into other educational programs are working in their field, one has a consulting business and one is working in an unrelated field. Four students are employed by public environmental agencies and five are employed by the private sector. Although the College has a placement office to assist students in their employment search, a more effective method has been the mailing of letters to consulting firms, and sending brochures to colleges.

PROGRAM PROJECTIONS

The College obtained an initial three-year grant to develop the curriculum and a five year grant to conduct the training. Although only twenty students can attend tuition free under the EPA Grant, others elect to enroll in the program under their own expense. Depending on whether or not EPA will continue to fund the program beyond the initial five year period, current expectations are that the program will continue to expand. Plans are to upgrade the program to teach professionals in the field and new entries to obtain Grade II water plant operator certificates. Using multiple finding sources (including CETA), the continuing education program is to be developed and a survey is to be conducted (mostly EPA funded) of treatment plants to assess needs so as to be able to teach new techniques and instrumentation to encourage upward mobility.

One additional full-time instructor may be hired within the next three years to conduct training courses to meet the requirements of the Safe Drinking Water Act. The candidate would most likely be a water plant operator or supervisor in his present position. Additional part-time instructors are hired periodically to teach water quality laboratory techniques and other specialty areas.

Program officials see the new federal acts such as the Safe Drinking Water Act, 208 Planning, and the National Pollutant Discharge Elimination System, as providing good opportunities for jobs for graduates in fulfilling industrial-health needs. Programs which serve specific identified needs are best and those which produce well-rounded environmentalists are not as good because of job market needs in the future. Programs which are most flexible and able to adapt to changes will be most able to serve the needs of students, industry, and government. They will be able to remain through adaptation as viable on-going programs and be best able to instruct students and train and place them in jobs which will best utilize their skills.

COURSE DESCRIPTION (Sample listing)

ENV 101 Water Quality Laboratory Techniques I - This course assists the student in learning the use of basic laboratory equipment, instruments and glassware. The students will also learn analytical techniques for microbiological sampling, how to collect data, to report and interpret results, and how to recognize abnormal conditions and results and how to implement necessary changes. (3 s.h.)

ENV 102 Water Quality Laboratory Techniques II - The purpose of this course is to assist the student in learning the analytical techniques for the list of analyses necessary for monitoring in the National Polluton Discharge Eliminating System. (3 s.h.)

ENV 103 Water Quality Control Processes - This course assists the student in learning to name and recognize the unit processes found in various types of municipal and industrial wastewater treatment plants in order to communicate with plant operating personnel. (3 s.h.)

ENV 131 Environment & Life - This course assists the students in learning the major principles and facts in modern Biology and their application to the creation and solving of environmental problems and the diversity, adaptions, evolution and ecologic relationships of living things. (4 s.h.)

ENV 201 Water Quality Laboratory Techniques III (3 s.h.)

ENV 202 Water Quality Laboratory Techniques - These courses are sequential courses which prepare the students to do the analyses for monitoring as required by the NPDES. (3 s.h.)

ENV 203 Water Quality Laboratory Management - This course assists the student in preparing an inventory of the supplies and equipment used for the laboratory control procedures. (3 s.h.)

ENV 204 Water Quality Laboratory Management II - This course aids the student in the design and implementation of a monitoring and surveillance program. (3 s.h.)

ENV 205 Water Quality Laboratory Techniques - This course assists the student in learning to make measurements for volume, quantity of flow, time of flow, cross sectional area of stream and velocity for bodies of water using such instruments: pygmy current meter, price current meter, and others. (3 s.h.)

SECTION IV - BACHELORS DEGREE PROGRAMS

- Atlanta University Center -
  Georgia Institute of Technology
- Purdue University
- Rochester Institute of Technology
- The Pennsylvania State University-Capitol Campus
- Virginia Polytechnic Institute & State University

INSTITUTION: ATLANTA UNIVERSITY CENTER
GEORGIA INSTITUTE OF TECHNOLOGY

PROGRAM: Dual Degree Program/Water Pollution Control Design Engineering

DEPARTMENT: AUC - Science / Georgia Tech - Civil Engineering

DEGREE: AUC - Bachelor of Science (B.S.)
Georgia Tech - Bachelor of Engineering (B.E.)
(Water Quality Design)

CONTACT: Dr. Calvin L. Espy, Director
Dual Degree Program
Altanta University Center
360 Westview Drive, S.W.
Atlanta, Georgia 30310
(404) 534-0891

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Dual Degree Program of AUC and Georgia Tech joins the resources of the largest cluster of private colleges in the U.S. with a predominantly Black enrollment with those of a state university which has the largest undergraduate engineering enrollment in the U.S.

Presently, students attend one of the four undergraduate colleges, which compose AUC, for three years and then transfer to Georgia Tech for an additional two years. Shortly, a new plan will be initiated which stipulates that the student attend AUC for two years, after which he/she will spend one year in preparation for the transition to Georgia Tech. This year of transfer preparation is due to the fact that usually when a student transfers to Georgia Tech from AUC, his/her grades drop by one full grade point. Two degrees are earned simultaneously, a B.S. degree awarded by AUC and a B.E. degree by Georgia Tech in Water Quality Design.

It was expressed that considerable surprise existed over the high level of success in securing placements in directly related occupations. Initially, in 1974, it was thought that graduates would be hired as civil engineers but it was not anticipated that they would be employed as water quality control specialists, as is commonly the case. Careers which graduates are competent to pursue are as civil engineers, consultants, water quality systems designers, wastewater treatment plant managers, design consultants, construction advisors, federal, state and local policy advisors, and legal interpreters.

Nearly one-half of the funds for this program comes from the U.S. Environmental Protection Agency, and the remaining portion of financial responsibility is shared equally by AUC and Georgia Tech. AUC officials are awaiting EPA's decision concerning the continuance of the dual degree program in Water Quality Design. It is not likely to be refunded by EPA, in which case, as of June of 1978 this option will be terminated. Each student currently receives a tuition and book scholarship for this program.

PROGRAM REQUIREMENTS

"This program is directed toward the training of minorities, including women, in the complex problems associated with water pollution control", reports its director. For entrance into one of the four colleges which make up the Atlanta University Center one must have a high school diploma or its equivalent (GED).

Students who are interested in this option may enroll in Clark College, Morris Brown College, Spelman College, or Morehouse College. There they will pursue an undesignated science degree. One hundred and thirty-one hours embrace the general studies core curriculum as well as the pre-engineering courses. Twenty-nine hours of mathematics; thirty-nine hours of chemistry, physics, statics, and dynamics; and sixty-three hours of humanities and social science including English, philosophy, psychology and foreign language, are all required to be completed prior to transferring to Georgia Tech.

One hundred and three hours of predominantly civil engineering courses are required at Georgia Tech. Forty semester hours of the total are water quality related courses. Upon completion of the specified work at both AUC and Georgia Tech the student will be awarded a B.S. from AUC and a B.E. from Georgia Tech.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members administer Water Quality Design Engineering, one at AUC and one at Georgia Tech. In addition to these two, there are in excess of thirty people involved directly or indirectly in teaching courses, none of which are designated specifically for these dual degree students.

Although this is a small training program, it is at its enrollment capacity on its current budget. There are eight women and two men in their final year, and no new students were admitted during 1977-1978. All ten of the current students are expected to graduate in June of 1978. There were ten graduates last year as well.

The placement offices of both institutions have been effective in identifying potential placements. There is also a listing of employment contacts kept in each administrator's office. Two of the graduates continued their education and did graduate work at Georgia Tech, one in a water quality concentration through civil engineering, the other in sanitary engineering. Seven people have accepted positions with consulting firms dealing directly with water quality control and one person is working with the Georgia Department of Human Resources. Only one person has not been accounted for in the follow-up of the ten graduates so far.

PROGRAM PROJECTIONS

Should EPA decide to discontinue funding for this program, then it will admit no new students and will be terminated with the June 1978 graduation.

If sufficient funds to continue are generated then it is felt that the most deficient area of this curriculum is its lack of an internship, and work would begin on establishing placements with appropriate industries and municipalities.

COURSE DESCRIPTION

CE 4053 Applied Hydraulics - Analysis and design of hydraulic works and structures. Stability of dams, spillway design, stilling basins, culverts, pipe systems. (3 s.h.)

CE 4123 Sanitary Engineering III - Layout, hydraulic process and operational design of water and wastewater systems. Supervised design problems and inspection trips. (3 s.h.)

CE 4133 Engineering Aspects of Environmental Health - Sanitary engineering in public health administration and control of environmental health problems. (3 s.h.)

CE 4143 Man in His Environment - Population, resources, wastes and health as related to development of science and technology. (3 s.h.)

CE 4363 Applied Hydrology - Applications of hydrology in the design of hydraulic structures for water supply, irrigation, power, drainage and flood control facilities. (3 s.h.)

CE 4373 Water Resources Development - Comprehensive planning for water resources management, identification of needs, problems and issues, alternative creative solutions, economic and financial evaluation, institutional setting and public participation. (3 s.h.)

CE 4383 Groundwater Hydrology - Occurrence, distribution and movement of water below the surface of the earth, groundwater resources and dependable supply rates from wells, artificial recharge and waste disposal. (3 s.h.)

CE 4774 Application of Microbiology in Sanitary Engineering - Microbiology in environmental engineering. Relationship of protozoa, algae, bacteria and viruses to waterborne disease, treatment of wastes and deterioration of aquatic habitats. (4 s.h.)

CE 6114 Sanitary Engineering Design II - Theory and design of structures for collection, treatment and disposal of municipal sewage and industrial wastes, the industrial processes which produce liquid wastes. (4 s.h.)

CE 6144 Sanitary Engineering Processes I - Study of physical processes common to many water and waste treatment systems. Continuous flow models, flocculation, mixing, sedimentation, cake and filter medium filtration, gas and heat transfer. (4 s.h.)

CE 6149 Sanitary Engineering Processes II - Study of biological and chemical processes employed in water and treatment systems. Biological growth kinetics, activated sludge, trickling filters, lagoons and oxidation ponds. (4 s.h.)

CE 6353 Economic and Financial Aspects of Public Works Planning - Discounting techniques for public works planning. Microeconomics in project formulation. Applications from welfare economics, capital formation theory, input-output analysis. (3 s.h.)

CE 6358 Issues in Water Resources Planning and Management - Major public policy issues in water resources planning and management. Emphasis on American issues, but appropriate reference to issues in other countries. (3 s.h.)

CE 6363 Economics of Water Resources Development - Principles of resource allocation, benefit-cost analysis, water-resources project formulation, justification, allocation of joint costs in multipurpose developments. (3 s.h.)

INSTITUTION: PURDUE UNIVERSITY

PROGRAM: Environmental Sciences Option
DEPARTMENT: School of Science
DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. James Yackel, Associate Dean, School of Science
Purdue University
Mathematical Sciences Building
West Layfayette, Indiana 47907
(317) 494-8500

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The program began in 1973 and more than 70 courses are offered. It is interdisciplinary within the School of Science, although course work from many departments is accepted towards the environmental science option.

Options open to students include, but are not limited to: general environmental studies, air pollution, water pollution.

General environmental studies can be agriculturally oriented or science and engineering oriented. A minor in air pollution might be combined with a major in atmospheric sciences. A minor in water pollution might be combined with chemistry and geosciences. Each program is tailored to the student's professional orientation with the help of a faculty member or academic adviser.

PROGRAM REQUIREMENTS

Freshman admission requirements to the School of Science are:

1) high school graduate with 16 units: English (6), History or Social Studies (2), Algebra (3), Geometry (2), Trigonometry (1), Laboratory Science (2);
2) Indiana residents must be from the upper half of their high school graduating class and have SAT scores in the upper half of national norms;

   Out-of-state must be in the upper third of their high school graduating class and have SAT scores in the upper third of national norms;

3) SAT scores and College Entrance Examination Board achievement tests in English, Mathematics, Chemistry (used for academic placement);

4) information provided by high school counselor.

A B.S. in the General Science program requires 124 credit hours:

general scientific studies	35 - 40 hours
major science concentration	12 - 23 hours
additional scientific studies	4 - 10 hours
minor concentration	18 hours
general humanistic studies	27 - 28 hours
free electives	5 - 28 hours

In preparation for the environmental science minor, Ecology: BIOL 585-586, Programming I: CS 220, Experimental Statistics I: STAT 501, and one or more of 11 specified courses from Economics, Political Science or Sociology should be taken.

CURRENT FACULTY, STUDENTS, GRADUATES

There is no special faculty for the environmental studies options. Courses are offered through the regular academic departments of the School of Science and the faculty there numbers 280. Research has been done with Lake Michigan shore erosions, northern Indiana dunes, population ecology and field ecology.

Presently there are 15 enrolled in the program; 4 graduate yearly. Fifty percent of the students receive employment in goverment, 25 percent in industry and 25 percent in other areas.

About 200 undergraduate students are assisted financially through teaching assistantships, research assistantships or an hourly wage. A co-operative program is also available. Students complete two years of school and then, while working on campus or during the summer, take four credit hours a semester. Obtaining a degree in this manner takes four and one-half years. In the past, arrangements have been made with government labs (i.e., Argonne) to provide these opportunities.

PROGRAM PROJECTIONS

The department sees no change in the long range goals and objectives of the program. The various options are seen as continuing to be chosen by a small number of students. The impetus for change will need to come from a small nucleus of faculty.

ADDITIONAL INFORMATION

The School of Science has four departmental libraries: Chemistry, Geosciences, Mathematical Sciences, and Physics. The Department of Biological Sciences is served by the Life Science Library.

COURSE DESCRIPTION (a partial listing; others available from agriculture, entonomology, forestry, horticulture, civil, mechanical, electrical engineering)

Undergraduate:

Bio. Sciences: 285 Environmental Biology - Interactions of the biotic and abiotic components of natural environments. Ecological principles and phenomena associated with populations, communities, and ecosystems. Natural selection and other aspects of evolution. Principles of conservation. (3 s.h.)

Computer Sciences: 220 Programming I - Introduction to the intuitive notion of an algorithm; representation of algorithms in narrative form as flow charts and as computer programs; general structure of computers; computer experience using a procedure-oriented language in programming algorithms such as those used in elementary numerical calculations, sorting, simulation of a random process and symbol manipulation; definition and use of functions, subroutines and iterative procedures; survey of a variety of significant uses of computers. (3 s.h.)

Physics: 200 Our Physical Environment - Selected topics in physics which relate to man's environment. Particular emphasis will be placed on energy resources, relationships between medicine and physics, and modern applications of discoveries in physics. (3 s.h.)

Undergraduate/Graduate courses:

Atmospheric Sciences: 539 Air Pollution Meteorology - Sources of air pollution and variations of pollutants with space and time. Concepts of hydrostatic stability and turbulent flow in the atmospheric boundary layer, with application to urban diffusion models. Requirements and limitations of air pollution measurements, a total monitoring program and analysis of data. The role of macroscale circulation systems and large scale weather prediction in air pollution potential forecasting. Principles of radiation transfer and cloud physics applicable to potential climate modification by air pollutants. (3 s.h.)

Biological Sciences: 585 Ecology - Examination of ecological principles derived from study of patterns of distribution and abundance in plants and animals; structure and function in populations, communities, and ecosystems; role of population genetics, adaptation, and evolutionary theory in ecology. (2 s.h.)

586 Laboratory in Ecology - Laboratory and field studies designed to demonstrate ecological principles; sampling

586 (Cont'd) - methods and problems of experimental design; application of selected statistical methods in the analysis and interpretation of data; simulation models in population genetics, population ecology and ecosystem function. (2 s.h.)

Statistics: 501 Experimental Statistics I - Fundamental concepts and methods of statistics for students interested in the analysis of experimental data. Subjects include descriptive statistics, basic probability theory, normal distribution, tests of hypotheses and confidence intervals for normal and Bernoulli populations, contingency tables, tests of goodness-of-fit; linear regression and nonparametric tests. (3 s.h.)

INSTITUTION: ROCHESTER INSTITUTE OF TECHNOLOGY

PROGRAM: Civil Engineering Technology - Environmental Option

DEPARTMENT: Civil Engineering

DEGREE: Bachelor of Technology

CONTACT: Robert E. McGrath, Jr., P.E.
Staff Chairman, Civil Engineering Technology
Rochester Institute of Technology
One Lomb Memorial Drive
Rochester, N.Y. 14623
(716) 464-2183

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This three year Bachelor of Technology program at Rochester Institute of Technology is offered by Institute College within the School of Applied Science. An Upper Division Baccalaureate Program, the environmental controls option within Civil Engineering Technology places emphasis on wastewater and water treatment. These upper-division engineering technology programs are designed to accept only associate degree graduates from similar engineering technology fields. The programs provide continuity in providing continued study in the student's area of specialization. Components of the program include professional studies, liberal education, mathematics, and on-the-job training. Senior year students can select technical electives in their area of specialty so as to further career objectives.

A major stress of the program is the Cooperative Work Plan which enables students to alternate periods of academic study and related industrial employment. This plan also enables students to defray part of their educational expenses while participating. Cooperative Work Plan program students finish the degree program in three years rather than two and provides an advantage in enabling students to become familiar with direct application of techniques, skills, and latest developments in a given field of engineering technology.

Graduates of the environmental option within the Civil Engineering Technology Program are qualified for employment with consulting engineers, supervisory positions within water and wastewater treatment plants, and engineering departments of federal, state, and local governmental agencies. Coop students working within municipal engineering departments often receive job offers to stay after graduation as supervisors or operators of treatment plants.

Because both the School of Applied Science and the College of Engineering share their facilities, Civil Engineering Technology students have access to many laboratories and facilities. For example, the program has its own water and wastewater pollution control laboratory but access is provided to chemistry and microbiology laboratories within the College of Science, the Electrical Engineering Laboratory and the Hydraulics and Fluid Mechanics Laboratory. Students may also utilize remote terminals feeding into the Institute's Sigma 9 computer among others.

PROGRAM REQUIREMENTS

Students holding an associate degree in the appropriate technology area from a community, junior, or technical college will receive full credit if they enroll in an upper-division curriculum leading to the bachelor of technology degree in engineering technology. To enroll in the Civil Engineering Technology Program, an associate degree in civil or construction technology or its equivalent is required with a minimum 2.0 grade point average. Structured into the environmental option curriculum are 105 quarter credit hours spread over a three year period. Fourteen Civil Engineering Technology courses are required in areas, i.e. hydraulics, report writing, water supply and distribution, design of water and wastewater treatment facilities. In addition, five general electives, two technical electives, and one free elective are incorporated in the curriculum. Technical electives, with departmental approval, may be selected from courses offered in mathematics, physics, chemistry, engineering, and technology. Students with special abilities may work on independent study projects for credit under sponsorship of a faculty advisor.

Under the Cooperative Work Plan, the entering (junior) class is divided into two sections with half of the students starting with a co-op job, and the other half beginning academic work. This procedure rotates between quarters for the duration of the three year program.

New York state residents are eligible on the basis of need to receive awards ranging from 100 dollars to 1,500 dollars per year under the tuition assistance program. This program in effect equalizes the differential in tuition between private and state educational institutions. Rochester Institute of Technology Scholarships and Grants are also available along with other federal run programs, e.g. Basic Educational Opportunity Grant, etc.

CURRENT FACULTY, STUDENTS, GRADUATES

Four full-time and two adjunct faculty members teach the Civil Engineering Technology Program's courses. The two adjunct faculty members (one full time equivalent) each teach two courses per quarter.

There are currently (fall, 1977) 120 students enrolled full-time in the program of whom three are female. In addition, four students are enrolled on a part-time basis. An average of 35 students graduate each year and many (10 to 12%) continue on for further study. Many continue their studies at Manhattan College, the University of Massachusetts, the University of Rhode Island, SUNY at Buffalo, Syracuse University, Oklahoma and Cornell.

The RIT Central Placement Office assists students in their employment search and program officials estimate that virtaully all graduates find employment in their field, although a few secure employment in related fields such as land-use planning. Co-op employers also often offer students working for them permanent jobs also. In addition, the Civil Engineering Technology Program will also refer students to potential employers if the employers call directly. Few students (10%) find employment with governmental agencies and most(90%) find that consulting firm employment pays more and is more accessible. One potential drawback to securing public agency jobs is the New York State Board requirement for Engineering and Land Surveying that requires Bachelor of Technology graduates to obtain additional experience prior to being eligible to take the New York State Professional Engineer examination.

PROGRAM PROJECTIONS

Because student enrollment is steadily increasing, one additional faculty member is expected to be recruited. The new faculty member is anticipated to be an environmental engineer with a Master of Science degree. There are no plans to add any new options to the present Civil Engineering Technology curriculum.

COURSE DESCRIPTION

Graduate courses ITEC:

420 Hydraulics - Study of liquid flow in pipes and open channels, devices to measure pressure, the introduction to design of sewer and water lines. (4 q.h.)

428 Report Writing - Principles of organizing data and information. The techniques of library research, and oral reports. (2 q.h.)

430 Water Supply and Distribution - The consideration of water sources, surface and groundwater geology, criteria for quality and quantity, storage systems, and other standards are explored. (3 q.h.)

434 Environmental Pollution - The study of various forms of pollution including air, thermal, noise, pesticides, radiation, and visual pollution, with the investigation of the sources, measurement, methods of control, legislation, codes, and enforcing agencies. (3 q.h.)

436 Design of Sanitary and Stormwater Drainage Systems - A survey of population estimate techniques for sewage flow determination, application of basic hydraulics to the analysis and design of sanitary and stormwater collection system for a subdivision, and other topics. (3 q.h.)

438 Principles of the Treatment of Water and Sewage - An introduction to water and wastewater treatment interpretation of analyzed physical, chemical, and biological parameters of water quality with regard to the design and operation of treatment processes and to the control of the quality of natural water; fundamental principles employed in water and wastewater treatment; analysis of waste assimilative capacity of streams. (4 q.h.)

514 Land Planning - The basic concepts of zoning. (2 q.h.)

510 Design of Water Treatment Facilities - Principles of water treatment plant design. The topics discussed include the design of a rapid sand filtration plant with water softening treatment. (3 q.h.)

520 Design of Wastewater Treatment Facilities - Principles of wastewater treatment plant design; conceptual and hydraulic design of activated sludge and trickling filter plants are studied. Tertiary treatment facilities, such as nitrogen and phosphorous removal will be discussed. (4 q.h.)

549 Environmental Engineering Project - Theory and laboratory study of certain aspects of water pollution control treatment processes. (4 q.h.)

INSTITUTION: THE PENNSYLVANIA STATE UNIVERSITY (CAPITOL CAMPUS)

PROGRAM: Water Resources Engineering Technology

DEPARTMENT: Civil Engineering Technology; Division of Engineering and Technology

DEGREE:

Bachelor of Technology with major in Water Resources Engineering

CONTACT: Dr. Charles A. Cole, Associate Professor
Water Resources Engineering Program
W-261 Main Building, Capitol Campus
The Pennsylvania State University
Middletown, Pennsylvania 17057
(717) 789-1613

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Water Resources Engineering Technology program was started in 1967 to train an engineering technologist to bridge the gap between scientific advancement and practical treatment systems. This major prepares students in the various skills necessary to assume responsibility in the design and operation of water and wastewater treatment plants and design of collection and distribution systems. The program emphasizes applied engineering and all courses contain laboratory sessions. During the senior year the student takes the Engineer in Training examination (E.I.T. exam) and after suitable experience may be registered as a professional engineer in several states.

Graduates hold positions as designers in the sanitary or municipal sections of consulting engineering firms, environmental specialists with state governments, process engineers in the waste sections of a paper mill, engineers with river basin commissions, plant operations engineers in consulting engineering firms, and sanitary districts.

Students have access to a laboratory for analysis and operations and pilot treatment plants which include sand filters and unit processes of water and wastewater treatment.

PROGRAM REQUIREMENTS

The program accepts engineering technology associate degree graduates and engineering transfer students who can fulfill admission guidelines for a minimum of 60 credits of prerequisite courses (partly elective and required). Associate degree students should have a grade point average of 2.40 in their previous work.

The Water Resources Engineering Program has developed two programs of study for either associate degree students or transfer students. The programs consist of eighteen courses, three courses per term for six terms. This upper-division Bachelor of Technology degree program requires completion of 57 credits for associate degree students and 58 credits for engineering transfer students. The senior year in the program is an entire year of specialization concentrating on water resources material not normally included in a civil engineering program. Seniors are also permitted to take the Engineer-in-Training examination offered in Pennsylvania.

Students are exposed to current methods and procedures through detailed projects and field trips to treatment plants and are given lectures by practicing engineers and government officials. Financial aid available to the program's students consists of U.S. Environmental Protection Agency Agency Grants for Water Quality Management degrees which cover partial tuition.

CURRENT FACULTY, STUDENTS, GRADUATES

Five full-time faculty members contribute to the teaching of the program's curriculum. As individual faculty members they participate in a variety of research activities. Current research is funded by the National Science Foundation, industrial chemical companies (DOW, Dupont, etc.), and the Pennsylvania Department of Agriculture.

There are currently 45 full-time students (3 female) enrolled in the Water Resources Engineering Technology Program. Twenty- seven are seniors and eighteen are juniors. An average of 20 students graduate annually with the Bachelor of Technology degree from the program. Enrollment has been steady and the number of graduates each year varies between 15 to 25 students.

Although the program is designed to be terminal, approximately two percent (one of 50) continue on for Master's degrees. Approximately 25 percent continue on as part-time students. Those that do continue usually go to the following program: University of Pittsburgh, Villanova, Capitol Campus' Master of Engineering Program, and Penn State's Environmental Engineering Program.

It is estimated that 95 percent obtain employment in their field. Approximately 70 percent obtain positions in the private sector (most consulting firms) and 30 percent find government jobs. Engineering students begin having job interviews on campus during their senior year. Faculty contacts and employers calling the department looking for graduates are the best methods of assisting students in finding jobs.

PROGRAM PROJECTIONS

The Water Resources Engineering Program is developing a new Water Quality Management Technology option. This new option will not involve a different degree program as EPA has encouraged faculty to develop this option within the existing program structure. It is to be offered during the 1978-1979 school year. Present staff will be utilized to teach the new option's courses (e.g. 208 planning, etc.). An internship program will be included as part of the new option's program

The Water Resources Engineering Technology Program is continuing to grow and shifting its emphasis. The shift is from wastewater topics to water and solid waste management.

COURSE DESCRIPTION

(the following is a partial listing of courses)

CET 201 Plane Surveying - Theory and practice related to topographic, construction, and property surveys. (4 s.h.)

CET 202 Engineering Surveys - Basic principles of photogrammetry, control surveys, state plane coordinate systems, field astronomy, curve and volume computations, and hydrographic surveys. (4 s.h.)

CET 231 Structural Design - Elements of structural design and detailing in timber, steel, and reinforced concrete, design specification; use of handbooks, structural drafting practice. (4 s.h.)

CET 241 Civil Engineering Materials - Origin and use of construction materials, characteristics and use of soils, aggregates, portland cement, and bitumens as construction materials. (4 s.h.)

CET 301 Sanitary Chemistry and Sanitary Microbiology - Chemical and microbiological principles, with interpretation of analytical results in water supply, wastewater treatment, and stream pollution surveys. (4 s.h.)

CET 311 Water Pollution Abatement - Mechanisms of stream purification; fundamentals of sewage and industrial waste treatment; water pollution criteria. (4 s.h.)

CET 312 Hydrology and Water Supply - Variation in and sources of water supply; water treatment, distribution, and usage. (4 s.h.)

CET 321 Sewage Treatment Plant Design - Analysis of factors in development wastewater collection and treatment design criteria. (4 s.h.)

CET 322 Hydraulic Structures and Water Plant Design - Analysis of factors in developing design criteria; design concept; financing, construction supervision. (4 s.h.)

INSTITUTION: VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

PROGRAM: Civil Engineering Technology

DEPARTMENT: Division of Engineering Technology

DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. Richard Walker
Director, Department of Civil Engineering
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 951-6635

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Civil Engineering Technology program is an option within the Division of Environmental Technology. It is a two-year program consisting of junior and senior level courses which offer the student the opportunity to specialize in the water resources-environmental area.

The program was initiated in 1972, and designed to prepare students for occupations such as the design of sewage treatment plants, and the planning and construction of sanitation facilities for both industry and local governments.

Civil Engineering Technology is supported entirely by the University and is not the recipient of any research or training grants. Laboratory facilities of the Civil Engineering Department are available for use in conjunction with the program.

PROGRAM REQUIREMENTS

Admission requirements stipulate that a student must be a graduate of a related regionally accredited engineering technology program in a community college or have completed/the equivalent of the first two years of an engineering program at an accredited institution. Additionally it's required that entering students have completed math through differential calculus, one year of physics, nine quarter credits of English and speech, twelve quarter credits of social science or humanities, two courses in drafting, statics and strength of materials, four quarter credits of chemistry, and forty-one quarter credits of technology courses related to the civil engineering option.

The program consists of one hundred and two quarter credits of which twelve are electives and three are for a senior project which is the investigation of a problem related to the student's principal area of study. There are no minors offered in the program, however there is a senior year specialty in water resources-environment. This affords the student the opportunity to specialize in such courses as air pollution, environmental engineering design, environmental health, plant operations, and hydrology.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members, whose duties are limited to teaching, comprise the program. The program is supported solely by the University and no research funding is currently available.

Students come primarily from two-year colleges since the program was designed for this type of student. Approximately one-fourth of the students are, however, transfers from four-year colleges. There are currently fifty-two full-time and no part-time students enrolled. Most students, about eighty percent, are from Virginia. The program does not actively recruit out-of-state and most students are recruited through personal visits by program personnel to community colleges. Few students currently in the program are receiving financial assistance.

The program averages about twenty graduates each year and this figure has remained stable throughout the duration of the program. Almost all graduates soon find employment in the civil engineering environmental field. It is estimated that about eighty percent work in the private sector, primarily engineering consulting firms, while the remainder work for governmental agencies. Most graduates are placed in jobs through faculty contact with employers and through the VPI placement office.

PROGRAM PROJECTIONS

Currently there are no plans to expand the program. The College of Engineering is conducting a review of degree programs and the Engineering Technology program will be phased out in 1981.

COURSE DESCRIPTION

Undergraduate courses:

ETC 3020 Applied Hydraulics - Analysis of hydraulic components of engineering projects; design of open channels, closed conduits and hydraulic structures. (3 q.h.)

ETC 3030 Environmental Engineering Chemistry - Fundamental principles of organic chemistry related to biochemistry of water and wastewater treatment. (3 q.h.)

ETC 3050 Environmental Engineering Lab - Methods of analysis employed in water treatment, water supply surveillance, wastewater treatment, and stream quality monitoring and interpretation of test results. (4 q.h.)

ETC 3060 Design of Water and Sewer Systems - Design and installation of municipal water distribution and sewage collection systems. (3 q.h.)

ETC 4010 Air Pollution - Health and technical aspects of air pollution; methods of control; laws and regulations; measurement and evaluation procedures. (4 q.h.)

ETC 4011-4012-4013 Environmental Engineering Design - Design of wastewater treatment facilities: primary and secondary treatment processes; water quality control; and other topics. (3 q.h.)

ETC 4022 Plant Operations - Operational practices of physical, chemical and biological processes employed in water and wastewater treatment. (3 q.h.)

ETC 4020 Environmental Health I - Public health planning and administration; environmental sanitation; municipal and rural sanitation. (3 q.h.)

ETC 4021 Environmental Health II - Pollution of the aquatic environment; biological, physical, and chemical changes resulting from the pollution of streams, lakes and estuaries. (3 q.h.)

SECTION V - MASTERS DEGREE PROGRAMS

- Clemson University
- Clemson University
- Kansas State University
- Manhattan College
- Montana State University
- Northeastern University
- Rice University
- The Pennsylvania State University
- University of Hawaii
- University of Nebraska
- University of Tennessee
- University of Wyoming
- West Virginia University

INSTITUTION: CLEMSON UNIVERSITY

PROGRAM: Planning and Management

DEPARTMENT: Environmental Systems Engineering

DEGREE: Master of Science (M.S.)
Master of Engineering (M.Engr.)

CONTACT: Dr. Thomas M. Keinath, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
(803) 656-3276

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Environmental Systems Engineering (ESE) at Clemson University grew out of a group of faculty members formerly housed within the Department of Civil Engineering. The mission of this group was to provide graduate level education of environmental engineering professionals in response to specific needs of the State of South Carolina. After four years, in 1966, a graduate program in Environmental Systems Engineering was formally established as a separate entity within the College of Engineering. In 1968, a Formal ESE Department was established.

Originally, there were four areas of specialization within ESE: Water and Wastewater Treatment Systems, Natural Systems, Environmental Science, and Planning and Management. An Air Pollution specialization was added in 1976. The Environmental Sciences specialization was merged with Natural Systems in 1977.

At the master's level, the M.S. or the M.Engr. may be pursued within each area of specialization. The M.Engr. degree program is accredited by the Engineers' Council for Professional Development at the advanced level. A program of study for the Ph.D. is also offered, which provides more flexibility for specialization. Within these degree programs, emphasis is placed upon applying the basic principles of the sciences and engineering to the design, operation, planning and management of man-made environmental control systems. These include water and wastewater treatment facilities, air pollution control devices, and the analysis and management of natural systems such as streams, estuaries, and impoundments, as well as the air environment.

The Planning and Management concentration focuses on water resources development, and was designed to train individuals with modern skills and insights to plan and manage basin-wide or regional environmental protection systems. Pollution control facilities are not viewed as separate entities, but as components of a more comprehensive system. Students emphasizing this area may elect to emphasize either the planning aspects or the systems aspects. Each student takes a core of courses covering water and waste treatment systems, water pollution, hydrology, planning and analysis. Further specialization may take place through the selection of electives.

Since the formal organization of the ESE Department, it has attracted over two million dollars in external funding, including over one-half million dollars in training grant monies from federal and state agencies. Research funds to date have chiefly gone towards the fields of water treatment and water pollution. Active research in the water resources development/planning and management field has included river basin planning and management, regional water quality modeling, assessing the impact of electric power generation, and the evaluation of alternate sites for industrial facilities. Students may become involved with research activities through special projects or as paid research assistants. Master's level students normally participate in applied research. The department houses twelve research laboratories, a precision analytical instrument room, an operations and process laboratory, and a hybrid computer.

In addition to direct education of graduate level students and the conduct of research, the ESE faculty is of service to the state and region through several other means. Short-term training or retraining has been provided to citizens, governmental agencies, industries and consultants since the mid-1960s in the form of workshops, conferences, seminars and short schools. Some of the workshops/seminars carried out in the past related to planning and management were in the areas of systems applications in sanitary engineering, coastal zone pollution management, mathematical modeling, and environmental impact statement preparation. All of these programs resulted in hard copy proceedings for use by participants for further self-study.

The faculty also participates in a wide variety of professional activities such as serving on relevant state and federal boards and commissions, assisting in the development of technical curricula and curriculum materials, presenting testimony before Congressional committees, participating in educational television and radio programs, authoring papers, and chairing national and international symposia. One faculty member has served as an expert advisor to the Environmental Protection Agency (EPA), and all faculty members are actively involved with professional environmental associations.

PROGRAM REQUIREMENTS

Admission to the ESE programs requires a bachelor's degree in engineering or a scientific discipline such as chemistry or biology. Non-engineers must have had prerequisite course work in mathematics through differential equations, one year each of chemistry and physics, and courses in computer programming, fluid mechanics, and general environmental engineering. Applicants for the M.Engr. degree program must have a B.S. degree in engineering from an ECPD accredited institution with at least a 3.0 cumulative grade point average on the last sixty semester hours to be eligible for acceptance. Engineers who have had at least two years of documentable professional engineering experience may be granted full admission provided they had an undergraduate grade point average of 2.5 or higher. All M.S. program applicants must have earned at least a 3.0 cumulative grade point average on the last sixty semester hours, and must have taken the Graduate Record Examinations with a score of at least 1000, for full admission. An engineering degree is not required for entrance into the M.S. program; applicants may be eligible with B.S. degree in such fields as biology, physics, chemistry or mathematics, as long as prerequisite course requirements are met. Provisional admission may be considered for students not meeting the minimum requirements.

Thirty semester hours are required for the master's degrees. One calendar year is normally required for completion of the master's degrees, although working as teaching or research assistants can prolong the length of study. Each student selects a major advisor. An advisory committee, chosen by the department head, the major advisor and the student, approves the student's graduate degree curriculum, supervises the graduate program, administers the final oral comprehensive examination, and initiates the recommendation for the awarding of the degree. The Graduate School requires that all M.S. programs include six semester hours of research if the thesis option is chosen. Most students elect a two- to three-hour special problem course in lieu of the thesis. Of the remaining required hours, at least half must be selected from courses numbered 800 and above. For the M.Engr., at least half of the required hours must be selected from courses numbered 700 and above. A special project is required for the M.Engr. degree.

ESE students pursuing the Planning and Management concentration take a core of seven courses, or nineteen semester hours, and select electives basic upon specific career objectives. A minor, if selected, consists of at least six hours of credit in the chosen area.

The College of Engineering offers cooperative graduate programs with industry in which semesters of on-campus study are alternated with work assignments in industry. ESE students rarely participate in these programs, as they lengthen the term of study.

CURRENT FACULTY, STUDENTS, GRADUATES

The ESE Department consists of seven faculty members, all holding the Ph.D. degree, with teaching and research interests and responsibilities in diverse environmental fields. As faculty members' activities overlap into two or more of the areas of specialization, identifying the number of faculty for each area of specialization is not possible.

There are currently five master's students in the department in the Planning and Management concentration; the number of students enrolled in this program and in the department has been relatively stable over the last five years. The average number of graduates with the Planning and Management specialization is approximately four. In general, ESE graduates with the M.S. degree are more likely to become employed by governmental agencies, while those with the M.Engr. are more likely to enter the private sector. Graduate follow-up data from 1974 to 1977 indicate that of sixty-four graduates surveyed, eight became employed by industries, twelve by consulting firms, thirty-nine by governmental agencies (local, state, and federal), and five continued their schooling for the doctoral degree. These figures include ESE graduates with the Ph.D.

Approximately 95 percent of the ESE students receive financial assistance from a variety of sources, including research assistantships, teaching assistantships, and training grants. The department has had EPA training grants which have supported students in air and water quality.

PROGRAM PROJECTIONS

Although the department is close to reaching the maximum number of students it can accommodate with the space available, it is expected that within three years, the overall enrollment will increase from the present average of forty to forty-five, to approximately sixty. A portion of this growth will be in the Planning and Management program.

COURSE DESCRIPTION

Core courses:

ESE 602 Water and Waste Treatment Systems - Study of fundamental principles, rational design considerations, operational procedures of unit operations and processes, physiochemical and biological treatment techniques. Introduction to integrating unit operations and processes into treatment systems. (3 s.h.)

ESE 846 Pollution of the Aquatic Environment - A study of the effect of pollution resulting from domestic and industrial wastes upon the physical, chemical, and biological characteristics of natural waters. (3 s.h.)

ESE 861 Environmental Systems Engineering Seminar - Discussion of current advances and research developments in various areas of environmental engineering. Off-campus speakers, students, and faculty participate. (1 s.h.)

WRE 865 Hydrology I - Hydrologic cycle as a hydrologic system; deterministic hydrology; all aspects of physical hydrology emphasizing balanced approach to ground water hydrology and surface water hydrology; meteorology, infiltration, soil moisture, and evapotranspiration; probability analysis and partial system systhesis by unit hydrograph techniques. (3 s.h.)

WRE 870 Stream and Estuarine Analysis - Physical, chemical and biological processes and relationships which exist in streams and estuaries; estuarine environment, free-flowing streams, mechanisms which describe transport of conservative and non-conservative materials through estuarine system; estuary as a resource and techniques for its management. (3 s.h.)

WRE 875 Water Resources Planning - Water resources planning emphasizing river basin and regional aspects; purposes and objectives of water resources development, historical review, changing emphasis over time, current practice and guidelines as well as new approaches and techniques, public and private sector involvement in water resources planning and development, formulation of alternative plans and their analysis, public participation and resolution of conflicts, institutional and social dimensions of water resources planning and plan implementation, water quality and water quantity and their interactions. (3 s.h.)

WRE 876 Water Resources Systems - Water resources systems area; application of current operations research and systems engineering techniques and their use in analysis, evaluation, design, operation and management of water resources systems; water quality systems including reservoirs, regional environmental control systems, power-generating facilities, industrial water supply and pollution abatement systems. (3 s.h.)

Selected approved electives:

MATH 671 Applied Statistical Decision Theory - An introduction to statistical decision theory emphasizing the Bayesian approach. Behavioral axioms, characterizing the "Rational decision maker", lead to the laws of probability theory and utility theory. Includes axioms of subjective probability and utility, extensive and normal form analysis, likelihood principle, conjugate distributions. (3 s.h.)

EX ST 801 Statistical Methods - Role and application of statistics in research; estimation, test of significance, analysis of variance, multiple comparison techniques, basic designs, mean square expectations, variance components analysis, simple and multiple linear regression and correlation, and non-parametric procedures. (4 s.h.)

SE 803 Engineering Optimization and Applications - Nonlinear programming, search methods, dynamic programming and discrete optimization; quadratic programming, linearization, direct search, gradient methods, penalty functions, recursive optimization and implicit enumeration. (3 s.h.)

E&CE 850 Computation and Simulation - Computer modeling as related to engineering problems; matching problems and computers to obtain most effective solution. (3 s.h.)

AG EC 804 Water Resource Policies - Economic, social and legal aspects of the control, use, development and management of water resources and related public policies. (3 s.h.)

AG EC 805 Seminar in Marine Resources Management and Policy - Economic, institutional and legal aspects of the control and management of common-property marine resources. Management systems for coastal zone and continental shelf resources. (3 s.h.)

RPA 705 Recreational Aspects of Water Resources - Relationship of recreation to water; history and legislative background; governmental involvement; current research related to planning, pollution, and demand. Future policy decisions. (3 s.h.)

CRP 612 City and Regional Planning Theory - The philosophical, methodological and ethical aspects of planning are explored through selected readings, student reports, lectures and discussion. A critical examination of planning theories. (3 s.h.)

CRP 672 Implementation of the Local Planning Process - The organization and administration of types of planning agencies and their relationship to other governmental and private organizations. The function and relationship of the various implementing tools available to local government. (3 s.h.)

INSTITUTION: CLEMSON UNIVERSITY

PROGRAM: Water Treatment Systems

DEPARTMENT: Environmental Systems Engineering (ESE)

DEGREE: Master of Science (M.S.)
Master of Engineering (M.Engr.)

CONTACT: Dr. Thomas M. Keinath, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
(803) 656-3276

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Water Treatment Systems is one of four areas of specialization within the Department of Environmental Systems Engineering, College of Engineering, at Clemson University. As one of the original specialization areas, the program was first offered in 1962, and in terms of enrollment is by far the largest area of specialization.

As with the other three program areas, master's level students may pursue either the M.S. or the M.Engr. Those students electing the Water Treatment Systems specialization receive education focused on the fundamentals and applications of modern pollution control techniques. Graduates of this program are prepared to design water and wastewater treatment systems that may employ new and advanced physiochemical or biological techniques, and to implement modern approaches to water and wastewater treatment such as renovating wastewater for direct recycle and reuse.

ESE students may become involved with research activities through individualized special projects, or by working as research assistants. Active research in water treatment systems includes the following: computer based control strategies for wastewater treatment plants, dynamic model and control strategies for the activated sludge and anaerobic digestion processes, simulation of competetive sorption in continuous flow reactors, physiochemical treatment of textile finishing wastewaters, dynamic modeling of clarification and thickening, and dynamic modeling of wastewater lagoons. Funding for ESE projects has come from such sources as the Environmental Protection Agency (EPA), the South Carolina Department of Health and Environmental Control, the U.S. Army, Duke Power Company, J.P. Stevens, and Westinghouse Corporation. Among the special facilities available for research in the department is a two-story unit operations and process laboratory.

In addition to numerous other public services, ESE faculty sponsor short schools periodically for water and wastewater treatment plant operators. These are three-day courses that provide basic operations reviews, designed to prepare operators for state certification examinations. During 1976, 274 persons were trained at these schools. The university also offers correspondence courses for water and wastewater operators that cover operations, maintenance, and laboratory procedures.

PROGRAM REQUIREMENTS

Admission to the ESE programs requires a bachelor's degree in engineering or a scientific discipline such as chemistry or biology. Non-engineers must have had previous course work in mathematics through differential equations, one year each of chemistry and physics, and courses in computer programming, fluid mechanics, and general environmental engineering. Applicants for the M.Engr. degree program must have a B.S. degree in engineering from an institution accredited by the Engineers' Council for Professional Development, with at least a 3.0 cumulative grade point average on the last sixty semester hours. Engineers who have had at least two years of documentable professional engineering experience may be granted full admission provided they have undergraduate grade point averages of 2.5 or above. Applicants for the M.S. degree must have an undergraduate grade point average of at least 3.0 on the last sixty semester hours, and must submit scores of at least 1000 from the Graduate Record Examinations for full admission. Entrance into the M.S. degree program does not require an undergraduate engineering degree. Provisional status may be considered for students not meeting the minimum requirements.

The M.S. and the M.Engr. require thirty semester hours of course work, which is normally completed in twelve months. Graduate School requirements include six hours of research if a thesis is prepared; of the remaining required hours, at least half must be selected from courses numbered 800 and above. The Graduage School requires that M.Engr. candidates select at least half of their required hours from courses numbered 700 and above. A special project is required for the M.Engr. degree.

Each student selects a major advisor. An advisory committee approves the curriculum, supervises the program, administers the final comprehensive examination, and initiates the recommendations for the awarding of the degree.

Students in Water Treatment Systems must meet the above requirements, and take a core of ten courses, or twenty-three semester hours. Electives may be selected based upon individual career objectives. The core courses and representative approved electives are described below.

CURRENT FACULTY, STUDENTS, GRADUATES

Seven full-time faculty members comprise the ESE Department. Faculty members are not assigned to specific program areas, but often teach courses and conduct research in two or more of these areas. There are currently twenty-five students pursuing the Water Treatment Systems specialization; approximately this number of students graduates annually with this area of emphasis. Generally, most M.S. graduates become employed by governmental agencies following graduation, while those earning the M.Engr. are more likely to enter the private sector (chiefly industries and consulting engineering firms).

The department has received training grants from EPA, which have supported students in the Water Treatment Systems specialization. Other sources of student financial support include teaching and research assistantships, and fellowships. Approximately 95 percent of the students in the department receive financial support.

PROGRAM PROJECTIONS

Although the department is close to reaching the maximum number of students it can accommodate with the space available, it is expected that within three years, the overall enrollment will increase from the present average of forty to forty-five, to approximately sixty.

Program officials project a shift of emphasis within Water Treatment Systems. In anticipation of increasing skilled workforce requirements of the Toxic Substances Control Act of 1977, in both the private and public sectors, there will be an expanded emphasis on the control of toxic pollutants.

COURSE DESCRIPTION

Core courses:

ESE 643 Environmental Engineering Chemistry I - Study of fundamental principles of physical and analytical chemistry applicable in treating waters and wastewaters: chemical thermodynamics, chemical kinetics, acid-base equilibria, complex equilibria, electrochemistry. (2 s.h.)

ESE 644 Environmental Engineering Chemistry Laboratory I - Demonstration of principles of ESE 443 and laboratory exercises in analytical methods used in water quality control. Wet-chemical and analytical techniques include residue analysis, turbidity, color, alkalinity, acidity, pH, hardness, iron, manganese, dissolved oxygen, biochemical oxygen demand. Modern instrumental techniques are studied. (2 s.h.)

ESE 802 Principles of Water Treatment Systems - Intensive study of fundamental principles of import to water and wastewater

ESE 802 (Cont'd) - treatment systems. Principles of biological and chemical reactions, mass and heat transfer, reactor kinetics, adsorption and ion exchange, clarification and thickening, transient response analysis and control theory, methods of operations research. (4 s.h.)

ESE 803 Laboratory in Principles of Water Treatment - Demonstrations and laboratory exercises to illustrate fundamental principles of water and wastewater treatment systems. Respirometer studies, reactor systems, dispersion, gas transfer, adsorption, thickening, control systems. Emphasis on relation between theory and experimental results. (1 s.h.)

ESE 804 Design and Operation of Water Treatment Systems - Investigation of design and operational criteria that are significant to processes employed for treatment of water and wastewater. Coagulation and flocculation, filtration, adsorption and ion exchange, membrane separations, chemical precipitation and water stabilization, chemical oxidation and disinfection, activated sludge, fixed-film biological reactors, anaerobic digestion, solids handling and disposal, municipal and industrial economics. (4 s.h.)

ESE 805 Laboratory in Design and Operation of Water Treatment Systems - Lab exercises in water and wastewater treatment processes. Coagulation, flocculation, filtration, reverse osmosis, softening, activated sludge, anaerobic digestion, sludge handling and disposal. Emphasis on operation of these processes and securing suitable design parameters. (1 s.h.)

ESE 806 Integrated Problems in Water Treatment Systems - Integration of processes involved in water and wastewater treatment into complex systems. Emphasis on functional design and operation through consideration of process economics and plant control systems. Utilization of team approach. (2 s.h.)

ESE 846 Pollution of Aquatic Environment - A study of effect of pollution resulting from domestic and industrial wastes upon the physical, chemical, and biological characteristics of natural waters. (3 s.h.)

ESE 862 Environmental Quality Case Study - In-depth analysis and investigation of a significant current or recent situation affecting or involving some facet of environmental quality. Study conducted by a team of students resulting in a comprehensive position paper. (1 s.h.)

WRE 875 Water Resources Planning - Purposes and objectives of water resources development, historical review, changing emphasis, current practices and new approaches. Public and private sector involvement, formulation of alternative plans and their analysis. Public participation and resolution of conflicts, institutional and social dimensions, interactions of water quality and water quantity. (3 s.h.)

Selected approved electives:

ESE 847 Pollution of the Aquatic Environment Laboratory - Field and lab investigations into physical, chemical, and biological effects from pollution of aquatic environment. (1 s.h.)

ESE 848 Environmental Engineering Chemistry II - Applications of principles of organic and biochemistry to problems of environmental control, waste treatment, bioengineering. (2 s.h.)

ESE 849 Environmental Engineering Chemistry Laboratory II - Theory and application of analysis as applied to measurements for environmental control. Spectroscopy and spectrophotometric techniques, electrochemical analyses, chromatographic methods of analysis, light scattering, electrophoretic measurements. Demonstrations and experiments in interfacing analytical instruments with small digital computer. (2 s.h.)

BIOCH 623 Principles of Biochemistry - Study of the chemistry of amino acids, monosaccharides, fatty acids, purines, pyrimidines and associated compounds leads to an understanding of their properties and relationship between structure and function. (3 s.h.)

CE 641 Applied Hydraulics - Advanced concepts of hydraulics within a framework of relevant engineering problems. Flow in closed conduits, flow in open channels, hydraulic structures, flow measurements, fluid machinery, sediment transport, unsteady flow. (3 s.h.)

CHE 806 Process Systems Analysis and Simulation - Formulation and solution of mathematical models describing dynamic and steady state behavior of chemical and physical process systems; methodology of systems analysis, and techniques of analog and digital solutions. (3 s.h.)

FM 816 Flow in Open Channels - Free surface flow problems including applications of digital computer, concepts of boundary layer theory, uniform and varied flow, hydraulic jump, design criteria for prismatic channels and transitions, some applications of unsteady flow. (3 s.h.)

MICRO 812 Bacterial Metabolism - Biochemical pathways occurring in bacterial cells; fermentations of carbohydrates and related compounds and of nitrogenous organic compounds; anaerobic and aerobic respiration; bacterial photosynthesis; nitrogen fixation; biosyntheses of amino acids, purines, pyrimidines, lipids, proteins, nucleic acids and polysaccharides. (3 s.h.)

SE 803 Engineering Optimization and Applications - Nonlinear programming, search methods, dynamic programming and discrete optimization; quadratic programming, linearization, direct search, gradient methods, penalty functions, recursive optimization and implicit enumeration. (3 s.h.)

INSTITUTION: KANSAS STATE UNIVERSITY (KSU)

PROGRAM: Sanitary Engineering

DEPARTMENT: Civil Engineering

DEGREE: M.S. in Civil Engineering (with specialization in Sanitary/Environmental Engineering)

CONTACT:
Dr. Lawrence Schmid
Department of Civil Engineering
Seaton Hall
Kansas State University
Manhattan, Kansas 66506
(913) 532-5862

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The M.S. degree in Civil Engineering at Kansas State University provides for specialization in Sanitary/Environmental Engineering. Since its beginning in 1963, students electing this course of study have followed a curriculum emphasizing practical training as opposed to research. Extension programs off-campus at Salina and Topeka allow professionals to upgrade their training through part-time coursework.

Facilities are deemed adequate by the faculty for teaching and for their specific research interests (biological waste treatment systems, stream pollution, agricultural waste management and disposal, nutrient removal from wastewaters, and urban storm water quality). The department maintains 1200 sq. ft. of laboratory space. The Water Quality Lab has equipment for conducting all major analyses for water and wastewater and a 50,000 gallon per day wastewater treatment pilot plant used to conduct large-scale studies in biological waste treatment. Faculty note that they are unable to do sophisticated potable water research given existing facilities. Previous research funding has come from the Kansas Water Resources Institute; Junction City, Kansas municipal government (feasibility of disposal of water treatment plant sludges); Environmental Protection Agency; and several private firms. Current support is in-house.

PROGRAM REQUIREMENTS

A B.S. degree in engineering or its equivalent is required for admission to the master's program in Sanitary Engineering. Entering students must have a 3.0/4 or better in the junior and senior years; admission may be granted to a student with an undergraduate average of 2.3/4 with strong recommendations, but full graduate standing is contingent upon attaining a 3.0/4 in the first semester of the Sanitary Engineering program. The Graduate Record Examination (GRE) is not required, but foreigh students must score a minimum of 600 on the Taking of English as a Foreign Language (TOEFL). To receive the master's degree, a student must complete either twenty-four semester hours of coursework and six semester hours of thesis or thirty semester hours of coursework and two semester hours of report. Either option gives the student some experience in communicating research ideas.

CURRENT FACULTY, STUDENTS, GRADUATES

Two full-time faculty members with teaching appointments in Civil Engineering serve one full-time and 15-20 part-time students (one woman) electing specialization in Sanitary Engineering (FTE=6). Because of the engineering core prerequisites, few students are drawn to this program from other academic areas. The number of graduates each year is approximately six, a number that represents a slight decline from previous years. Faculty note that salaries paid to students with a bachelor's degree in engineering attract many people away from additional coursework. The low stipends available to graduate students ($300-350/mo/student plus in-state tuition standing) provide only minimal support according to KSU staff in this program. Virtually all students completing this Sanitary Engineering curriculum find jobs in their field of training (63 percent as private consultants, 30 percent in enforcement and review positions in regulatory agencies).

PROGRAM PROJECTIONS

To expand the Sanitary Engineering program, faculty contend that there is a need for more money, more students, and more staff--three factors unlikely to increase in the future. If professionals are officially encouraged to upgrade their training regularly, more students may seek part-time coursework on the main campus at Manhattan or in the extension programs at Topeka and Salina.

COURSE DESCRIPTION

Biology:

Biol. 693 Limnology - Studies of inland lakes and streams. Emphasis is placed on water as a physical and chemical environment as it affects the nature of biological interactions and productivity. (2 s.h.)

Civil Engineering:

CE 761 Sanitary Engineering Chemistry - Application of basic concepts of chemical equilibria, physical chemistry, organic chemistry, and biochemistry to the field of sanitary engineering. (3 s.h.)

CE 762 Water Treatment Systems - An in-depth study of the basic physical, chemical, and biological factors and their application in the design of water supply and water quality control systems. (3 s.h.)

CE 766 Wastewater Treatment Systems I - A study of wastewater treatment systems applied to domestic and industrial wastewaters. Emphasis is placed on the basic biological concepts applicable to the design of conventional wastewater treatment systems. (3 s.h.)

CE 767 Wastewater Treatment Systems II - A study of advanced wastewater treatment systems including nutrient, suspended solids, and trace organic removals, along with treatment and disposal of the resultant solids. Emphasis is placed on synthesis of the various processes into the total treatment scheme. (3 s.h.)

CE 863 Advanced Topics in Sanitary Engineering - On demand. For graduate students in Sanitary Engineering. The course provides a forum for the discussion of advanced topics in Sanitary Engineering. Research being conducted at this and other institutions is analyzed critically. (1-3 s.h.)

INSTITUTION: MANHATTAN COLLEGE

PROGRAM: Environmental Engineering and Science

DEPARTMENT: Civil Engineering

DEGREE: Master of Science (M.S.)
Master of Engineering (M.E.)

CONTACT: Dr. John S. Jeris
Director, Environmental Engineering and Science
Manhattan College
Bronx, New York 10471
(212) 548-1400

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Environmental Engineering and Science program at Manhattan College has as its objective the training of specialists in the control and prevention of water pollution. This graduate program began in 1962 as a sanitary engineering program, and was changed to its present title in 1969.

Primary emphasis of the program is on the practical applications of water pollution control. A secondary emphasis is the preparation of students for work in water pollution control research. This program is designed to provide the specialized knowledge and competence needed to analyze, design, and synthesize engineering systems for water pollution control and water quality management and participate as a full professional person in water pollution control programs.

Facilities used in support of the program include the Unit Operations Laboratory, along with all of the chemical and microbiological facilities of a complete water and wastewater analysis laboratory.

PROGRAM REQUIREMENTS

Admission requirements for either degree include a bachelor's degree with adequate preparation in the following three areas:

Mathematics - general equivalent of analytical geometry, calculus, and differential equations.

Basic Sciences - equivalent of one year of courses in general chemistry and introductory physics.

The M.E. program additionally requires the undergraduate degree to be in engineering and have at least three credits in solid mechanics and three credits in fluid mechanics plus courses in electrical circuits and thermodynamics. The M.S. program is generally designed for students without a baccalaureate degree in engineering.

Requirements for the M.E. degree include the completion of an approved program of study consisting of at least thirty credits. Twenty-one of these must be selected from courses offered in the environmental engineering and sciences program and must include courses in applied chemistry, water and wastewater treatment, and natural water systems.

The M.S. degree requires completion of a program of at least thirty-four credits. Twenty-one credits must be taken in courses offered in the environmental engineering and sciences program and must include a course in special topics or a thesis.

CURRENT FACULTY, STUDENTS, GRADUATES

Program faculty consists of five members, four full-time and one part-time. Three of the full-time members and the part-time member divide their time equally between teaching and research and the remaining full-time member spends his time in both teaching and administration. Research funds are currently available from EPA and the National Oceanic and Atmospheric Administration. Previous funding has come from the National Science Foundation and private industry.

There is a total of eight full-time students currently in the M.S. program with three part-time students. Enrollment in the M.E. program includes twenty-one full-time and twelve part-time students. About twenty percent of the students can be considered career change, coming from disciplines such as biology. About sixty-five percent of the program's students are recruited from the undergraduate programs at Manhattan, although program officials also send out information to other schools for recruiting purposes. A majority of the students are from the New York City metropolitan area. Financial assistance is available in a number of forms, including training fellowships, research assistantships, lab assistantships, scholarships, and the work-study program.

Approximately twenty students per year graduate from the program, although this number varies. This figure includes eighteen graduates in the M.E. program and two in the M.S. program. Half of the graduates find employment in the private sector, with industry or consulting firms, and another fifty percent work for governmental agencies. Placement of graduates is usually done through referrals from employers, program faculty, or the college placement office.

PROGRAM PROJECTIONS

Officials indicated that no expansion of the program or increase in the faculty is anticipated in the near future.

ADDITIONAL INFORMATION

The program is also responsible for an annual summer institute in water pollution control which offers one week courses in biological waste treatment and mathematical modeling of natural systems. This attracts approximately fifty students per year in each course.

COURSE DESCRIPTION

(the following is a partial listing of courses)

701 Mathematics Models II Application of the principles and techniques of mathematical models to complex water quality problems in natural and engineering systems. (2 cr.)

702 Environmental Statistics Probability density functions; binomial, Poisson, normal chi square and t distributions; regression analysis; time series analysis; harmonic analysis. Application of statistical principles to environmental data with emphasis on water environment. (2 cr.)

705 Water Quality Time Series Analysis Harmonic analysis; smoothing and filtering of data; particular applications to continuously recorded data from monitors, and data from water quality field surveys. (2 cr.)

716 Principles of Water and Waste Treatment I The theory underlying the physical and chemical processes employed in the treatment of water and waste waters. Applications of principles to process design. (3 cr.)

720 Water Resources Hydraulics Backwater curves in open channels and natural streams, various methods of integrating the non-uniform flow equations. Application of pumps to water resources problems, theory and application of water hammer. (3 cr.)

721 Hydrology and Oceanography The hydrologic cycle; rainfall, run-off, evaporation, droughts and floods; principles of physical and chemical oceanography; other topics of current interest.

725 Systems Analysis and Water Quality Management Review of water quality and quantity models, time variable and frequency response models, models of three-dimensional systems, feedback models; other topics. (2 cr.)

408 Environmental Engineering IV: Treatment Plant Design Design and analysis of environmental control facilities to provide high quality drinking water and minimize adverse environmental affects of treated wastewaters. Design and cost estimate of pump station. Water treatment plant analysis; unit operations; design standards; hydraulic profiles. Design and cost estimate of wastewater treatment plant. (3 cr.)

INSTITUTION: MONTANA STATE UNIVERSITY

PROGRAM: Environmental Engineering & Environmental Health Engineering
DEPARTMENT: Civil Engineering
DEGREE: Master of Science (M.S.) in Civil Engineering

CONTACT: Dr. Robert L. Sanks
Dr. Howard S. Peavy
Montana State Universtiy
Bozeman, Montana 59715
(406) 994-2111

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

There are two environmentally related graduate programs in the Department of Civil Engineering at Montana State University: environmental engineering; and, environmental health engineering. Instituted in 1967 at MSU, environmental engineering is a rigorous, technical program which prepares students either for advanced studies or for professional practice within the public or private sector. Environmental health engineering is normally a terminal, broad-based program which prepares students usually for employment in government. This is a new program at Montana State, having been established in 1974.

At the present time, both of these programs lead to the Master of Science degree in civil engineering. However, efforts are being made to change the environmental health engineering program degree. Suggested as a more accurate degree title, was Master of Environmental Health Engineering.

The major emphasis of the graduate environmental engineering program is water quality control. Although the study of water and wastewater is the primary orientation, students of this program may also consider supplemental course work in air pollution, radiological health, and solid waste management. Students usually maintain a science or mathematics minor.

The environmental health engineering program is directed at developing planning and administrative skills in order to prepare the graduate for positions involving the direction of community projects, or the public health engineering and control of air and water quality.

The university is equipped with pilot plants for nearly all usual water and wastewater treatment processes. Well equipped laboratory facilities are also available for student and faculty uses.

PROGRAM REQUIREMENTS

Requirements for completion of the M.S. degree in the area of environmental engineering include completion of at least 45 quarter hours of course work. Thesis is optional.

The M.S. degree in the area of environmental health engineering requires completion of 80 quarter hours and one summer spent in field experience. This program is a two-year program.

CURRENT FACULTY, STUDENTS, GRADUATES

The faculty associated with both of these master's level environmental programs, consists of three full-time teaching and research personnel. All are cost-centered through the Department of Civil Engineering.

Enrollment in the environmental engineering program consists of seven full-time male students. The environmental health engineering program includes eight male and three female full-time students. The new environmental health engineering program attracts a substantial number of career change students.

Graduates from the programs have averaged, over the last few years, approximately five each. The actual number of graduates for 1977 included seven from environmental health engineering and two from environmental engineering. However, these figures represent a slight increase over the last few years.

PROGRAM PROJECTIONS

A minimal amount of growth is anticipated for these programs over the next three years. The environmental health engineering program may expand somewhat.

Significant changes in either faculty or students most likely will not occur in the near future. Courses, especially in the newer program, may receive some rescheduling and/or revision, but new areas of concentration are not likely.

COURSE DESCRIPTION (Selected)

C E 509 Engineering Seismology - Occurrence and nature of earthquakes, wave types and propagation, seismic instruments, analysis of strong motion records. (3 q.h.)

C E 526 Design of Earth Structures - Engineering design of earth dams, embankments, slopes, excavations, underground conduits and highway subgrades. (3 q.h.)

C E 530 Advanced Hydraulic Engineering I - Advanced topics in open channel flow. (4 q.h.)

C E 532 Advanced Hydraulic Engineering II - Topics in the hydraulics of ground water flows. (4 q.h.)

C E 534 Hydraulic Engineering Investigations - Laboratory and field investigations for design and analysis in hydraulic engineering. (4 q.h.)

C E 540 Environmental Engineering I - A nontheoretical approach on the quality of water and the effect and costs of treatment. (4 q.h.)

C E 541 Environmental Engineering II - Principles, theory and practice of water treatment. (4 q.h.)

C E 542 Environmental Engineering III - Principles, theory and practice of wastewater treatment. (4 q.h.)

C E 543 Industrial Water and Wastes - Principles and methods of treating industrial water and wastes. (4 q.h.)

C E 544-545 Environmental Engineering Lab I, II - The objective of these courses is to learn by doing and to compare experimental results with theoretical results. (2 q.h.)

C E 546 Radiological Health Engineering - Radiation theory, detection and shielding in relation to organisms sources, radioactive wastes, water and food supplies and decontamination. (4 q.h.)

C E 548 Environmental Engineering Chemistry - Application of physical, organic, qualitative and quantitative chemical principles for solution of environmental engineering problems. (1-5 q.h.)

C E 561 Water & Waste Analysis - Analytical techniques for measuring quality of water and wastewater. (4 q.h.)

C E 562 Water Supply Planning - First in series of environmental health engineering courses. To acquaint students with the fundamentals of securing, treating, and delivering potable water to a community. (4 q.h.)

C E 563 Liquid Waste Treatment - Second in a sequence of environmental health engineering courses. To acquaint students with the fundamentals of collection and treatment of municipal wastewater. (4 q.h.)

C E 564 Municipal Facilities Planning - Third in series of environmental health engineering courses. To acquaint students with procedures of initiating, financing, siting and constructing municipal facilities. (4 q.h.)

C E 570 Individual Problems - Directed research and study on an individual basis. (1-5 q.h.)

C E 580 Special Topics - (1-5 q.h.)

INSTITUTION: NORTHEASTERN UNIVERSITY

PROGRAM: Environmental Engineering and Science

DEPARTMENT: Civil Engineering

DEGREE: Master of Science (M.S.)

CONTACT: Dr. John J. Cochrane
Chairman, Department of Civil Engineering
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115
(617) 437-2444

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental Engineering and Science at Northeastern prepares students for professional occupations in the water and wastewater fields. The graduate program began as an evening program for part-time students in 1952 and added a day program in 1965.

The program comprises four areas of specialization from which a student may select, including water and wastewater engineering, environmental health engineering and science, water resources engineering, and air pollution engineering. Courses are offered in both day and evening and a cooperative program is available in which a student spends two quarters of the first year and one quarter of the second year in the academic program and the remaining quarters plus the summer following the first year in professional employment. Both an M.S. degree in Civil Engineering and an M.S. without specification are awarded by this program.

Program support facilities include a water pollution control laboratory which is capable of analyzing water and wastewater samples in physical, chemical, and biological regimes, and an air pollution laboratory capable of sampling ambient air, gaseous and particulate pollutants, and evaluating the physical, chemical, and biological characteristics of atmospheric pollutants.

PROGRAM REQUIREMENTS

Admission to the program for the M.S. degree in Civil Engineering requires a B.S. degree in Civil Engineering, with an acceptable quality of undergraduate work, from a recognized institution. For the M.S. degree, applicants may have a B.S. degree from a recognized institution in some other engineering field or related science and an appropriate background of preparation.

Requirements for the Master's degree include forty quarter hours of course work and a master's report worth four quarter hours of credit or a thesis worth eight quarter hours. A student must select one of the four areas of specialization and complete all courses required for that specialization. In addition, fourteen quarter hours of electives must be obtained from the environmental engineering courses offered by the Civil Engineering Department.

CURRENT FACULTY, STUDENTS, GRADUATES

There are presently nine faculty members in the program and they are responsible for teaching about three-quarters of their time and for research during the remainder. Funding for research is currently provided by EPA and the State of Massachusetts.

Currently there are two hundred and forty five evening students and sixteen day students. Most students are Boston area residents and are recruited through informal means. Northeastern is one of few schools in the area with an evening graduate program in environmental engineering. Presently, five students have EPA training grants and four receive University assistantships. There are also four students in the cooperative program.

Approximately thirteen students graduate from the day program each year and about thirty M.S. degrees are awarded to evening students. These numbers have remained constant over the past years and are expected to continue. Placement of graduates is not considered to be a significant problem since most are already employed while in the program. Most graduates are employed in the private sector or with government agencies.

PROGRAM PROJECTIONS

Program officials hope to expand the program with the addition of courses and an increase is research. Specifically, they would like to expand efforts in environmental planning and computer aspects of environmental control. This would probably require an additional two faculty members in the next two or three years.

COURSE DESCRIPTION

1.907 Environmental Statistics - Statistical studies applied to environmental data, including basic statistics; frequency and probability distributions; methods of frequency analysis; multiple linear regression and correlation analysis; introduction to mathematical modeling of environmental processes including discussion of deterministic and stochastic processes. (2 q.h.)

1.908 Hydrology I - Hydrologic cycle; precipitation studies including data adjustment, spatial and temporal variability, intensity-duration-frequency relationships; abstractions of water due to evapotranspiration and infiltration; groundwater flow, including flow nets and well hydraulics; and other topics. (4 q.h.)

1.910 Water and Wastewater Treatment I - Water qulaity, water impurities and effects, the theory and practice of water treatment, and the elements of design of water treatment works including intake facilities, wells, filtration, coagulation, sedimentation, softening, iron and manganese removal, disinfection, and fluoridation. (2 q.h.)

1.913 Industrial Waste Disposal - Evaluation of industrial waste problems and development of process design for the required treatment facilities; study of various manufacturing processes and their wastewater problems; industrial waste survey techniques; characteristics of industrial wastes; waste reduction methods; physical, chemical, biological, and advanced treatment methods; industrial wastewaters and disposal and treatment of industrial solids and liquids. (2 q.h.)

1.950 Air Pollution Engineering - Theory and practice related to envineering management of air resources; applications of models for the atmospheric dispersion of pollutants; analysis of control systems for gaseous and particulate emissions utilizing dry collection, wet collection, absorption, and catlytic processes. (2 q.h.)

1.952 Industrial Hygiene - Characterization and control of industrial problems associated with noise, hearing and ventilation. Physical and biological aspects of environmental stress are discussed. Emphasis is placed on the application of engineering principles to the design of control systems. (2 q.h.)

1.957 Air Pollution Science - Biological and chemical aspects of air pollution with emphasis on the toxicological aspects of the environment, physiological effects of aerosols, analysis of organic and inorganic constituents of the atmosphere and rationale for establishment of air quality criteria and standards. (2 q.h.)

1.985 Environmental Protection - Environmental quality and its effects on health, comfort, aesthetics, balance of ecosystems and renewable resources; interaction of the water-land-air complex, vector control, food protection, ionizing radiation, other radiation, and the energies of heat and sound. (2 q.h.)

INSTITUTION: RICE UNIVERSITY

PROGRAM: Environmental Science and Engineering

DEPARTMENT: Environmental Science and Engineering

DEGREE: Master of Science (M.S.) in Environmental Science

CONTACT: Dr. C.H. Ward
Chairman, Environmental Science and Engineering
Rice University
Houston, Texas 77001
(713) 527-8101

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Instituted in 1970, the environmental science and engineering program at Rice University, is interdepartmental. The major areas of emphasis are on water and wastewater engineering. Water resource management and applied water chemistry are also strong areas of concentration in this graduate program. The program leads to the Master of Science degree in environmental science or in environmental engineering. Although there is also a doctoral program offered, the following narrative is directed at the master's program.

Graduate students at the master's level in this program take the majority of their course work from other departments. These departments may be chemical engineering, architecture, biology, geology and economics, in partical listing.

Financial assistance is available in the form of graduate traineeships. Other forms of student financial aid are available through the university.

PROGRAM REQUIREMENTS

Candidates for the Master of Science degree must successfully complete at least eight approved semester courses. In addition, students must present and defend under oral examination, a research thesis. Usually two academic years, as well as the summer in between, are needed to complete the requirements. There are university requirements which must be fulfilled at the master's level, as well as those outlined above.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty involved in the environmental science and engineering program totals 48 persons. There are four full-time and nine part-time teaching personnel. In terms of full-time equivalency, this is equal to six. At present, the teaching staff is complemented by 35 full-time research persons. Of the total 48 full and part-time personnel, four are cost-centered.

The enrollment consists of 16 students. There are 11 male and four female full-time students. In addition, there is one female part-time student.

Graduates at the master's level have numbered from three to 10 over the last few years. Approximately 35% of each graduating class elects to continue their education, in pursuit of the doctoral degree. Of those choosing a career path, 95% enter private sector employment. Typical of the chosen occupations of these graduates are the following: biologist; water/wastewater treatment plant operator; water pollution control biologist; water resources engineer; and, environmental engineer.

PROGRAM PROJECTIONS

Substantial changes in the faculty number or in the student population are not anticipated to occur during the next few years. Faculty and staff are interested in pursuing up-grading of courses.

COURSE DESCRIPTION (selected)

Graduate courses:

511a, 512 b Environmental Physiology and Toxiocology - The physical and chemical environment as it affects the physiology and population dynamics of organisms. (3 s.h. each)

517a Water Resource Systems - Theories of urban hydrology, stream pollution analysis, and water quality simulation. (3 s.h.)

521, 522 Environmental Engineering Processes - Design and control of industrial systems to satisfy water quality demands for cooling water and steam production. (3 s.h. each)

536b Microbial Engineering - The synthesis of water and wastewater treatment systems. (3 s.h.)

545 Modeling in Design and Resource Management - The use of models in design and resource management. (3 s.h.)

550b Applied Water Chemistry - Designed to provide a theoretical basis for considering the chemistry of natural and waste waters and treatment processes. (3 s.h.)

601a, 602b Seminar - A continuing seminar on environmental research. (3 s.h. each)

645a, 646b Problems in Environmental Planning - An important current environmental problem will be studied. (3 s.h. each)

INSTITUTION: THE PENNSYLVANIA STATE UNIVERSITY

PROGRAM: Environmental Pollution Control

DEPARTMENT: Intercollege

DEGREE: Master of Science (M.S.); Master in Environmental Pollution Control (MEPC); Master of Engineering (ME)

CONTACT: Dr. John B. Nesbitt
Charge of Graduate Programs in Environmental Pollution Control
226 Merrell R. Fenske Laboratory
Pennsylvania State University
University Park, Pennsylvania 16802
(814) 865-1226

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

First initiated in 1971, the Environmental Pollution Control Program is an intercollege program dealing with various aspects of the control of air and water pollution and the disposal of solid wastes. Options are available in: Air Environment; Basic Physical and Biological Sciences; Environmental Health; Environmental Resource Management; Land Environment; Mathematics, Statistics, and Computer-Science; Noise; Planning; Pollutant Control in Industrial Processes; Radiological Protection; Systems Analysis; Water Resources - Quantity; and Water Resources Quality. An interdisciplinary faculty committee and participating departments provide graduate instruction. Other graduate faculty members other than those in the committee have a teaching and/or research interest in the area of environmental pollution control. Graduates are prepared to enter positions with consulting engineering firms, state, local, and federal regulatory agencies, and in private industry. Many have found positions with the Pennsylvania Department of Environmental Regulation and the Department of Transportation. Some have found employment with the U.S. Geologic Survey and EPA, for example. They have served in the capacities of operation plant inspectors, water or air pollution control specialists (not engineers), engineering assistants or technicians,and have prepared environmental impact assessments for consultants.

Research facilities utilized by the program's students are those maintained by the various participating departments at the University. There are none specifically designated for the Environmental Pollution Control Program. Research work conducted by students are sponsored by the various departments associated with the program.

PROGRAM REQUIREMENTS

Admission into the program is granted upon the recommendation of the head of the academic department in which the student plans to complete a program and the environmental pollution control program faculty committee. Mathematics through integral calculus, and one year of work in both general physics and chemistry is normally required for admission. Considered for admission are students with appropriate backgrounds in mathematics and science and a 2.75 junior-senior average.

Students enrolled in the Environmental Pollution Control Program are required to pass 9 credits of EPC core courses and 3 credits of EPC 590 seminars. One credit of the seminar in air is given during the fall term, one in water is given during the winter term, and one credit in solid waste management is offered during the spring. The core courses are: CE 472, Water Pollution Control Processes; CE 476, Solid Waste Management; and ME 470, Fundamentals of Air Pollution. Students not choosing to major in Water Pollution Control may substitute CE 473, Water Quality Management for CE 472, Water Pollution Control Processes.

In addition to the 12 credits of core courses and seminars, a minimum of 12 of the remaining 18 credits required for the master's degree must be selected from the EPC recommended courses list.

Master of Environmental Pollution Control: at least 9 of the student's total credits must be at the 500 level and these 9 credits should not include EPC seminars or credits taken to write the MEPC paper.

Master of Science in Environmental Pollution Control: at least 18 credits at the 500 and 600 level and these may include the EPC Seminars; and for most departments a thesis must be written.

Students can develop, with the help of an advisor in the selected department of affiliation, a program that will specialize in one area yet provide a basic comprehension of the problems encountered in other areas of environmental pollution control. The proposed program study, approved and signed by the student's advisor, is normally submitted to the program office within the first three weeks.

The student advisor, the head of the department of affiliation, and the EPC Program Chairman, determine the requirements concerning the research paper or thesis.

The university provides eight terms (2 years) of financial assistance to graduate assistants. Additional graduate assistance is provided through the student's departmental affiliation and usually involves work on funded research projects.

CURRENT FACULTY, STUDENTS, GRADUATES

A total of forty faculty members contribute to the offering of the courses in the program. Thirty-three faculty are senior graduate faculty members and seven are associate graduate faculty members. They devote about 70 percent of their time to teaching activities and 30 percent to research.

There is a total of 26 full-time students enrolled in the Environmental Pollution Control Program. All except one student are male and there is only one part-time student in the program. About one-half of the students are affiliated with the Civil Engineering Department and the rest are from Agronomy, Veterinary Science, Mining Engineering, Geography, Meterology, Food Science, and Biological Health. Ten to fifteen students have graduated annually in recent years and the four-year average is 14 students. Enrollment and the number of graduates have remained relatively stable over the past couple of years.

The Environmental Pollution Control Program is designed to be a terminal Master's program. Resumes of students enrolled in the program and the Center for Air Environmental Studies are published and mailed to prospective employers. This has resulted in rather successful placement of graduates. About 95 percent of graduates find employment in their field and the rest are unknown. Approximately 30 percent find positions in governmental agencies, 40 to 50 percent in the private sector, and 20 percent in academia and other areas. Most finding positions with the Pennsylvania Department of Environmental Regulation serve as operations plant inspectors, conducting stream surveys, water or air pollution control specialists. Those finding positions with consulting firms are employed as engineering assistants or technicians, prepare 208 Areawide Planning Studies, prepare environmental impact assessments, and in sales. Some graduates take further fluid mechanics or waste treatment courses and thus obtain engineering work with consulting firms.

PROGRAM PROJECTIONS

Because of time and fiscal constraints, no change is expected to develop with the Environmental Pollution Control Program. The present orientation of the program is considered to be adequate in structure and no additional faculty members are expected to be recruited. There appears to be a leveling off of enrollment in the program to 25 to 30 per year.

COURSE DESCRIPTION

(the following is a partial listing of courses)

CE:

451 Advanced Hydrology - Recent advanced in deterministic, stochastic, and urban hydrology. (3 s.h.)

472 Water Pollution Control Processes - Principles and design of unit operations for water; domestic and industrial wastewater treatment; equipment selection and application. (3 s.h.)

474 Management of Water Pollution Control Processes - Personnel requirements, record systems, unit process operation and control, laboratory control and equipment maintenance systems. (3 s.h.)

476 Solid Waste Management - Solid waste collection, salvage and disposal techniques for municipalities and industries; cost analyses; legislation; management; financing; design optimization. (3 s.h.)

554 Urban Hydrology - Several hydrograph methods. Design storm and IUH application; airport drainage; flood plains; impact of urbanization upon groundwater and sediment. (3 s.h.)

570 & 571 Physical Chemical Treatment Processes I & II - The theory of physical-chemical processes used in the treatment of potable water and municipal and industrial wastewaters. (2-3 s.h.)

573 Problems in Environmental Pollution Control - Investigations, analyses, and reports on current topics in environmental pollution control. (3 s.h.)

575 Industrial Waste Treatment - Surveys and data analysis; use of unit processes to meet regulatory agency requirements; disposal of gaseous and solid residues. (2 s.h.)

Mechanical Engineering

405 Air Pollution Control Systems - Small particles formation, properties, and behavior; equipment design and instrumentation; air pollution control, atomization, mass transfer, filtration. (3 s.h.)

458 Noise Control in Machinery - Nature of noise sources in machine elements and systems. Propagation and reduction of noise. (3 s.h.)

470 Fundamentals of Air Pollution - Nature, sources, transport, control, and effects of pollutants; sampling methods; air quality criteria and standards, economics, and planning. (3 s.h.)

Microbiology

400 Introductory Environmental Microbiology - Elementary ecological relationships of microorganisms in the biosphere; role of bacteria in water pollution and purification. (2 s.h.)

Recreation and Parks

542 Environmental Law - Legislative, judiciary, administrative processes-roles; citizen action; legal concepts; litigation and enforcement tactics for protection and enhancement of natural environment. (3 s.h.)

Nuclear Engineering

420 Radiological Safety - Ionizing radiation, biological effects, radiation measurement, dose computational techniques, local and federal regulations, exposure control. (3 s.h.)

INSTITUTION: UNIVERSITY OF HAWAII

PROGRAM: Environmental and Sanitary Engineering

DEPARTMENT: Civil Engineering

DEGREE: Master of Science (M.S.) in Civil Engineering

CONTACT: Dr. Reginald H.F. Young
Department of Civil Engineering
University of Hawaii
2540 Dale Street
Honolulu, Hawaii 96822
(808) 948-8111

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental and sanitary engineering program was established at the University of Hawaii in September of 1963. Water and wastewater engineering is the primary emphasis of the Master of Science degree program. Students, at this level, may specialize in areas such as industrial and domestic waste treatment, water supply and treatment, and water quality management. Graduates of this program gain employment at the professional level in water and wastewater design and regulatory occupations.

The University of Hawaii has several excellent research facilities. Graduate students and faculty are able to conduct and to assist with on-going research activities both on and off the campus. A partial listing of these research units includes the Water Resources Research Center, the Environmental Center, the Hawaii Institute of Marine Biology and the Environmental Health Unit of the School of Public Health.

The University of Hawaii is a land-grant institution located in the Manoa Valley on the island of Oahu near the capital city of Honolulu. Due in part to the distinctive geographical location, the University has achieved a reputation of excellence in engineering and applied sciences, in addition to the land-grant institution activities.

PROGRAM REQUIREMENTS

Admission requirements and procedures for the University of Hawaii graduate programs should be otained by the students at the appropriate time, from the Graudate School.

Requirements for the masters degree in civil engineering include: 30 semester hours of course work including two hours of seminar and nine hours of thesis (if required); and, at least 12 hours must be civil engineering courses at the 600 level. Students are encouraged to take CE 635 (environmental engineering chemistry), CE 636 (environmental engineering laboratory) if they have had no previous graduate study or work experience. No minor is required.

Additional departmental electives include: CE 643, 643 solid waste management and control; CE 640 industrial waste treatment; CE 641 marine disposal of wastes; CE 634 treatment plant design; and, CE 631 water quality management.

Students are recruited through the following methods: interviews (very helpful); direct contact in undergraduate classes (moderately helpful); and, letter soliciation (satisfactory). Usually this program does not attract career change students.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty totals two full-time members. Teaching activities are equal to 1.50 full-time equivalent, while research activities are equal to .50 full-time equivalent.

Student enrollment, at present, includes five male full-time, and four male plus one female part-time students. Approximately 10% of the students will elect to pursue higher educational degrees.

Graduates from the Master of Science in civil engineering program have averaged approximately eight per year over the last three years. This average is reflected in the following: 1975 = 9 graduates; 1976 = 9 graduates; 1977 = 6 graduates. A slight decrease in per annum graduates has occurred. However, overall, this program compares quite favorably with other graduate study areas at the University. Thus, the decrease in the 1977 figure may reflect that particular year across the graduate school at large, or it may reflect a possibly temporary decline in the number of masters level graduates nationally.

Student support includes federal and local government funds in the form of assistantships.

PROGRAM PROJECTIONS

The civil engineering program is forecast, by the faculty, to experience some growth and expansion in the next few years. This expansion, however, is predicated on the department and the college developing a doctoral program in this area of study. Long range objectives of the program include possible planned changes which would emphasize the academic areas of study (as compared to vocational, technical or applied).

Significant faculty growth is not anticipated in the near future, although an increase in student enrollment is probable. According to a recent program review, the annual civil engineer replacement needs of Hawaii are in excess of the number of students granted degrees from the University of Hawaii. In consideration of the reputation and strength of this program (regarded nationally as among the top 20), the faculty is encouraging the establishment of the doctoral degree offering in civil engineering. No time-lines have been established, however, as yet.

The program is accredited by the Engineering Council for Professional Development.

COURSE DESCRIPTION

CE 631 Water Quality Management - Evaluation of major environmental factors affecting water quality including urban, industrial, and agricultural activities. Engineering aspects of analysis are considered in relationship to control and management for water quality improvement. (3 s.h.)

CE 634 Treatment Plant Design - The functional design of water/wastewater/solids handling and treatment systems. (3 s.h.)

CE 635 Environmental Engineering Chemistry - The chemistry of water and wastewater, including instrumentation and process control evaluations and interpretations of results as used in practice. Basic concepts from general, qualitative, quantitative, and organic chemistry as it relates to the environment. (3 s.h.)

CE 636 Environmental Engineering Microbiology - Fundamental microbiology involved in environmental engineering processes and research with special emphasis on mixed culture systems, biochemistry, and microbiological aspects of water supply protection and wastewater treatment. (3 s.h.)

CE 637 Unit Operations and Processes Laboratory - Study of various unit processes in water, wastewater and water solids treatment, including the laboratory work necessary for the development of design criteria and the operation and control of these systems. A basic laboratory evaluation of the physical and chemical principles embraced in sanitary engineering unit processes and the interpretation of the data so obtained. (4 s.h.)

CE 640 Industrial Waste Treatment - Philosophy of industrial waste treatment. Waste characteristics, effects on collection and treatment systems and receiving waters, survey methods. Case histories of industrial waste problems including theoretical considerations for solution. (2 s.h.)

CE 641 Marine Disposal of Wastes - Types of wastes, their treatment and disposal; water quality standards; oceanographic variables and related data collection; diffusion and dispersion of effluent; ocean outfall design; ecological problems with pollutants; engineering problems with outfalls. (3 s.h.)

CE 642-643 Solid Waste Management and Control - Organization and operation of solid waste systems and programs at federal, state, and local government levels. Review of laws, ordinances, and regulations as well as relationship of solid waste disposal to air and water pollution control. (3 s.h.)

INSTITUTION: UNIVERSITY OF NEBRASKA

PROGRAM: Water Resources Engineering
Water Resources Planning and Management
DEPARTMENT: Civil Engineering (Engineering)
DEGREE: Interdepartmental (Planning and Management)
Master of Science in Civil Engineering (concentration in Water Resources)
Master of Science in any participating department in the Water Resources Planning and Management program
CONTACT: Dr. Gary L. Lewis, Assistant Director
Nebraska Water Resources Center
310 Ag. Hall
University of Nebraska
(402) 472-3305

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

In 1975, the Nebraska Unicameral designated the study of Water Resources as an Area of Excellence at the University of Nebraska, with leadership responsibilities in the hands of the Nebraska Water Resources Center. Prior to this time, two major graduate degree programs in water resources had been established at the institution--an M.S. degree in Water Resources Engineering offered through the Civil Engineering Department and a special M.S. degree minor in Water Resources Planning and Management awarded in conjunction with an M.S. major in one of several university departments. These degree programs together with an active Nebraska Water Resources Center and the Area of Excellence identification represent a scholarly and pragmatic commitment by the University to water quality and quantity research, training, and extension in Nebraska.

In addition to these formal courses of study, the Water Resources Center sponsors a variety of seminars, short courses, and conferences each year for municipal, government, industrial, and professional personnel. Recent meetings included a one-semester seminar series on "Water Resources Policy" for students and others, a one-week summer institute on "Future Planning" for water scientists, a special seminar for the managers of Nebraska's Natural Resources Districts on the issues of groundwater, and a two-day conference on "Water Problems in the Rural Environment" which was attended by 130 people from 18 states.

The research funding activities in the Water Resources area at the University of Nebraska total more than $1,000,000 annually. In addition to monies allocated by the state legislature for water research, the Water Resources Center and the Department of Civil Engineering have enjoyed past support from or are currently funded by the Environmental Protection Agency, U.S. Corps of Engineers, Economic Development Administration, U.S. Bureau of Reclamation, Office of Water Research and Technology, Old West Regional Commission, and contracts and grants at the local and state government and industry level.

PROGRAM REQUIREMENTS

Admission to the M.S. in Water Resources Engineering program requires completion of undergraduate training substantially the equivalent of that represented by the corresponding bachelors degree in the College of Engineering and Technology at the University of Nebraska. All students must complete the Engineering Hydrology and Hydraulic Engineering courses. Candidates electing the thesis option must complete a minimum of 30 hours with at least 18 hours in a major area and 9-12 hours in related areas; those students electing the non-thesis option must complete a minimum of 36 hours with 15-18 hours of major area coursework and additional hours in either one or two minor related areas.

The interdepartmental M.S. degree in Water Resources Planning and Management requires that each student complete a major in one of the 16 participating departments, nine hours of water resources related courses approved by the Program Advisory Committee, and normally a thesis oriented toward water resources planning and management. The master's degree is granted in one of the basic disciplines, and students are formally registered and must meet the admission requirements in one of the participating departments.

CURRENT FACULTY, STUDENTS, GRADUATES

The Water Resources Engineering program is staffed by one full-time and two part-time Civil Engineering faculty members. The part-time members spend their remaining time in the Water Resources Center as part of its faculty and administration. Any faculty member teaching water-resources courses in a participating department in the Planning and Management program is part of that program's staff. Over 80 water-related courses in 16 departments are available to students of this program.

There are currently two full-time and approximately 30 part-time Water Resources Engineering students for an FTE total of 12.0 (both Lincoln and Omaha campuses). Likewise, there are currently three full-time and approximately six part-time Planning and Management students producing an FTE equal to 7.0. All part-time students are concurrently full-time employees in state and federal agencies or industrial and consulting firms. Both programs, but particularly the Planning and Management sequence by its very nature, attract students from other disciplines (e.g., life sciences, physical sciences, civil engineering, geology, geography, limnology). Both of the full-time Engineering students and all of the three full-time Planning and Management students hold Graduate Research Assistantships. One quarter of the 60 undergraduate

Civil Engineering seniors and many students in other academic programs are supported by part-time jobs on water resources research projects.

Each program awards approximately three degrees annually. Few students pursue doctoral studies. Employment opportunities are excellent with Water Resource Engineering graduates entering state and federal government agencies and private engineering firms, and Planning and Management graduates locating in government and private firms as natural resource managers and water resource specialists. For both programs, roughly 30 percent of the students are employed in consulting, 30 percent in government, and 40 percent in industry.

Through the cooperative efforts of university departments and the Nebraska Water Resources Center, nearly 350 full-time students have received training in water resources since the Center was established in 1964. Between 1969 and 1977, nearly 220 graduate students from 25 different departments were involved in Center projects and thus received some excellent on-the-job training.

PROGRAM PROJECTIONS

The Area of Excellence designation has moved Water Resources to an elevated position on the University of Nebraska campus. Major objectives include developing the visibility of the program and building the curriculum at the graduate level. The future is bright though dependent on funding for teaching faculty, graduate student support, research facilities, and non-adjunct lines to attract top researchers to the program. A Nebraska Foundation, currently in formation, has earmarked its first $5 million for Water Resources, which would lend substantial impetus to the program. Departments are continuing to join the Planning and Management program and thus improving the curriculum offerings in that area.

COURSE DESCRIPTIONS

Civil Engineering:

852 Water Resources Development - Theory and application of systems engineering with emphasis on optimization and simulation techniques for evaluating alternatives in water resources developments related to water supply, flood control, hydroelectric power, drainage, water quality, water distribution, irrigation, and water measurement. (3 s.h.)

854 Hydraulic Engineering - Fundamentals of hydraulics with applications of mechanics of solids, mechanics of fluids, and engineering economics to the design of hydraulic structures. Continuity, momentum, and energy principles are applied to special problems from various branches of hydraulic engineering. (3-4 s.h.)

857 Engineering Hydrology - Introduction to the principles of engineering hydrology, with emphasis on the components of the hydrologic cycle: precipitation, evaporation, surface runoff, infiltration, drainage basin characteristics, streamflow, and precipitation runoff relationships. Emphasis is placed on utilizing these variables in forming engineering judgment. (3 s.h.)

910 Groundwater Hydrology - Fundamentals of groundwater flow, quantitative aspects of the occurrence and movement of groundwater, hydraulics of wells and well systems, recharge, seepage, salt intrusion, and groundwater models. (3 s.h.)

911 Advanced Hydraulics - Advanced studies in theoretical and applied hydraulics, involving applications of hydrostatics and hydrodynamics to problems of hydraulic design. (2-6 s.h.)

913 River Engineering - Gradually and rapidly varied flow in open channels, river control and navigation considerations, sediment transport and river models, unsteady flow. (3 s.h.)

914 Water Resources Planning - The techniques of comprehensive water resources planning considered relative to social patterns, political structures, economic objectives, technical requirements, and legal constraints. (3 s.h)

915 Water Resources Engineering - Techniques for relating economics objectives, engineering analysis, and governmental planning. (3 s.h.)

916 Interdisciplinary Seminar in Engineering: Economic and Legal Aspects of Water Resources Systems - Current and historic aspects of water law, hydrologic and engineering principles applied to water resource systems, governmental policies and planning. (3 s.h.)

961 Special Problems in Civil Engineering - Emphasis is placed on the reading and evaluation of technical publications concerned with theory and/or experimental data. Subsequent assignments are coordinated with the student's particular interests in his/her field of specialization. (1-6 s.h.)

989 Water Resources Policy Seminar - Emphasis on national, state, and local water policy procedures and important water resource planning and management issues facing the nation and Nebraska. (1-2 s.h.)

Area minors for the M.S. in Water Resources Engineering are: Engineering Mechanics, Water Resources, Hydrology, Hydraulics, Structures, Sanitary, Transportation, Geotechnical Engineering, Geology, Mathematics and Statistics, Business and Management, Agricultural Engineering, and Computer Science.

INSTITUTION: UNIVERSITY OF TENNESSEE

PROGRAM: Water Resources Development

DEPARTMENT: Water Resources Research Center

DEGREE: Master of Science (M.S.)

CONTACT: Mr. William F. Brander, Director
Water Resources Research Center
University of Tennessee
Knoxville, Tennessee 37916
(615) 974-2151

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The objective of this curriculum is to train personnel who will be fluent in the professional language of each of the numerous occupations which are in any way involved with water resources. Additionally, graduates are competent to plan, direct and coordinate the work of water resource agencies.

The Departments of Geology, Political Science, Environmental Engineering, Planning, Economics, and Agricultural Engineering offer courses which are cross-listed with Water Resources Development. Students may satisfy requirements with courses from any department within the university which his/her committee approves. Each student's curriculum is arranged individually with career objectives and academic and/or professional backgrounds under consideration.

Since its inception in 1966, the enrollment level has not increased substantially and no appreciable growth is anticipated.

PROGRAM REQUIREMENTS

Specific requirements for admission to this program are a bachelor's degree in law, engineering, or one of the physical or social sciences from an accredited college or university, and evidence of ability to do work of graduate quality, as ascertained by undergraduate records. Also considered are letters of recommendation and work records.

The exact curriculum of each student is decided upon in consultation with a faculty committee, depending on the background and field of interest of the student. Generally, the degree of Master of Science requires forty-five quarter hours of graduate study, including nine hours of thesis work. Ten courses are cross-listed with WRD and various other departments. Descriptions of these follow. Courses from any department in the university may satisfy part of the requirements so long as they are related and are approved. There is no internship but several federal training grants exist for these students.

CURRENT FACULTY, STUDENTS, GRADUATES

One person directs this program full-time with the assistance of a multidepartmental committee. Students take courses in many departments, which are subject to their advisory committee's approval.

There are ten full-time students enrolled in this option, eight of whom are Tennessee residents and two are foreign. Several of these students over the years have been enrolled for the purpose of upgrading their positions in current occupations. Four people are expected to graduate this year.

Occupational placement is not an easy task in this field. The campus placement office has had moderate to little success in locating positions. Students must take the initiative on their own to find work. Quite often they must be willing to relocate and/or wait for opportunities to arise. Follow-up shows that eventually most, if not all, of the students do find related placements, approximately 25 percent in private organizations, and another 70 percent plus in government positions.

PROGRAM PROJECTIONS

The program is in the midst of an evaluation which will determine whether it will expand, remain stable, or be reduced, so comments regarding its future are purely speculative. The director did express some discomfort with the possibility that WRD might become too specialized, which he considers a shortcoming for this curriculum.

COURSE DESCRIPTION

3410 Principles of Ground Water Geology - Ground and surface water, chemistry, mode of migration, and relation to the geological environment. (3 q.h.)

3565 Introduction to Public Administrative Organization and Management - Organization financing, and staffing of administrative agencies. Use and control of administrative process. Techniques of interagency coordination and cooperation. (3 q.h.)

4110 Managerial Economics - Economic theory applied to business decision making. Emphases on profit objectives, measurement and forecasting demand and costs, and capital budgeting. (3 q.h.)

4810 Water Law - Acquisition and exercise of water rights, including riparian rights, prior appropriation doctrine, and theories of ground water law. (3 q.h.)

5000 Thesis

5130 Planning Research Methods - Research methods in population, economic and social studies. Making of future projections and use of findings from the social science and other disciplines as the basis for planning decisions. (3 q.h.)

5160 Planning and Utilities - A study of legal, economic, engineering, and biological factors which are necessary for understanding various problems encountered by non-technical personnel in water quality activities. (3 q.h.)

5200 Water Resources Systems - Control, utilization, and management of water in water resources engineering. (3 q.h.)

5330 Descriptive Hydrology - Occurrence and description of elements of the hydrologic cycle. Effects of water on the earth. Relation of water to life. (3 q.h.)

5340 Hydrology of Agricultural and Forest Lands - Analytical approach to problems involving water surplus, deficiency and time distribution as related to agricultural and forest purposes. (3 q.h.)

5410-5420-5430 Interdisciplinary Seminars - Problems related to comprehensive water resource development including flood management, hydroelectric power, navigation, recreation, alternatives in water resource planning, tomorrow in today's planning, project formulation and justification, direct and indirect economic consequences, state and local participation, and municipal and industrial uses of water developments. (3 q.h. each)

INSTITUTION: UNIVERSITY OF WYOMING

PROGRAM: Environmental Engineering
DEPARTMENT: Civil and Architectural Engineering
DEGREE: Master of Science (M.S.) in Civil Engineering

CONTACT:
Dr. Robert L. Champlin
Associate Professor, Civil Engineering
University of Wyoming
P.O. Box 3334
Laramie, Wyoming 82070
(307) 766-4116

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental engineering program at the University of Wyoming is administered by the Department of Civil and Architectural Engineering. The Master of Science degree in environmental engineering involves a minimum of 30 semester hours of course work. This program, which was organized at the university in 1969, emphasizes the environmental areas of water and wastewater pollution control and abatement.

Graduates of this program find employment in the private sector, as a rule. Although approximately 10% of those graduates entering the workforce are employed by state and local agencies, the entering salary scales are a deterrent to students seeking professional positions.

The quantity and quality of Wyoming's water is a major concern to the population. Wyoming is primarily agricultural, but the increase in energy resource development across the state is impacted, substantially, by problems related to water quantity, as well as to quality. The slurring of coal is a current issue which presents questions, such as the loss of water to the agricultural community.

Students granted admission to this Wyoming program, receive training which benefits the state in the form of valuable, professional human resources. Qualified to develop solutions to water related problems, these students, historically, remain in Wyoming to become contributors to the future of the state.

PROGRAM REQUIREMENTS

Admission to the master's program in environmental engineering is contingent upon acceptance by the Graduate School and the departmental screening committee.

Requirements for the Master of Science may be completed by means of two graduate plans. Plan A requires a minimum of 26 hours of course work plus a thesis. Plan B requires a minimum of 30 credit hours plus one plan B paper. There is no minor in the traditional sense, but students emphasize areas of interest in environmental control.

Each graduate student at the master's level must fulfill 12 to 18 semester hours of core course work. Usually this core consists of civil engineering courses 740D, 741D, 742D, and 745D; plus three credits in basic microbiology. The core courses emphasize the area of water and wastewater. The remainder of the course work must be approved by the department.

The vast and varied natural resources of the state, offer unique opportunities for research. The University of Wyoming maintains several special programs and facilities for research and study. A partial listing includes the Jackson Hole Biological Research Station, the Laramie Energy Research Center, and the Natural Resources Research Institute. The Wyoming Geological Survey and the Wyoming Water Resources Research Institute also provide research units which interface with the environmental engineering program, as well as others.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty includes four-full-time teaching members who are cost-centered through the department. In addition, there are four part-time teaching personnel from the area of agriculture who assist with the master's program in environmental engineering.

At present, there are 10 full-time students involved in graduate study in environmental engineering. The program enrollment is defined as stable, but the University of Wyoming student population is increasing. Approximately 50% of the students are receiving financial support in the form of assistantships. Although there is no formal internship program, some students are involved in activities of this nature at the graduate level.

Graduates of this program have averaged 10 per year over the last three years. The post-graduate activities of these students is unofficially tracked through personal contacts within the department.

PROGRAM PROJECTIONS

The Master of Science in environmental engineering degree program has stablized over the last few years. No substantial growth is planned for this particular program. The department and the university are in the process, however, of developing two new areas of concern which will include environmental courses. These new concentrations will be in the fields of mining and construction, and are planned in response to the increasing energy resource development across the state. Plans for these new areas of concern will not be completed and operationalized for the next two to four years.

Pursuant to the expansion plans, additional faculty members and students will participate in these programs.

COURSE DESCRIPTION

CiEn 630D Hydraulics of Pipe Lines - The study of flow of incompressible and compressible fluids in pipes and pipe systems, unsteady flow and surge problems. (3 s.h.)

CiEn 631D [730D] Open Channel Flow - (3 s.h.)

CiEn 640D Environmental Engineering I - Theory and practice of collection of surface and groundwater; the chemistry and bacteriology of its purification are emphasized. An introduction is given to control and prevention of air pollution. (3 s.h.)

CiEn 641D Environmental Engineering II - The quantities, collection, transportation, and treatment of municipal and industrial wastes are considered. The bilogical and chemical relationships of treatment processes and steam pollution are stressed. (3 s.h.)

CiEn 660D Soil Mechanics I - A study of soil and the properties which influence its usefulness as an engineering material. Principles governing the movement of soil, water, and the propagation of the stresses through soil masses are studied. (3 s.h.)

CiEn 680D Hydrology - An introduction to the methods of hydrologic analyses with special emphasis on precipitation, evapotranspiration, streamflow, and techniques of measurement and interpretation. (3 s.h.)

CiEn 740D Water Treatment (B) - Advanced theory and practice of collection, purification, and distribution of potable water; special emphasis on purification techniques, and plant requirements and design. (3 s.h.)

CiEn 741D Sewage Treatment (B) - Advanced theory and practice of collection and treatment of industrial and municipal wastes; special emphasis on treatment techniques and plant requirements and design. (3 s.h.)

CiEn 742D Environmental Engineering Chemistry I - A study of the chemistry of natural systems, including: equilibrium chemistry of dilute aqueous systems, buffer systems in natural water, thermodynamics, and surface chemistry as related to destablization, stabilization, sorption, corrosion. (3 s.h.)

CiEn 743D Environmental Engineering Processes I - A study of microbial interactions utilized in environmental engineering processes, including: energy sources, microbial oxidation, microscopic environment control, degradation of carbon and specific complex problem compounds, mixed cultures, and pollution by algal nutrients. (3 s.h.)

CiEn 744D Air Pollution Principles (B) - The classification of gaseous and particulate air pollutants; atmospheric dispersion and predication methods; physical and biological effects of pollutants; sampling and analysis methods and techniques. (3 s.h.)

CiEn 745D Environmental Engineering Operations - A study of the fundamental processes used in environmental engineering, including: coagulation, flocculation, sedimentation, filtration, absorption, ion exchange, gas-liquid-solid transfer, oxidation thickening, and precipitation. (3 s.h.)

CiEn 757D Urban Planning and Design - Urban planning is the process of developing and implementing programs to meet the needs and to realize the potential of cities. This process consists of analysis of urban and regional problems and the synthesis of programs of action. Through this process, the planner works toward the establishment of balance and harmony in the interaction of the elements of man's environment. Contemporary urban planning concerns itself with the total scope of community activities and components. (3 s.h.

CiEn 760D Soil Mechanics II (B) - A study of stresses and stress conditions in soil, the application of the theory of limit of critical equilibrium, soil-bearing capacity, and earth pressure theory. (3 s.h.)

CiEn 761D [861D] Foundations and Embankment Engineering (B) - Application of soil mechanics theory to problems of settlement, reating walls, slope stability, pile foundations, and embankments. (3 s.h.)

CiEn 780D Water Resources Planning (B) - The application of hydrologic techniques applied to the development of plans for water resource utilization, including economic, legal, and political considerations. (3 s.h.)

CiEn 781D [881D] Ground Water Hydrology (B) - Laws governing the recharge, movement, and production of underground water. (3 s.h.)

INSTITUTION: WEST VIRGINIA UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Civil Engineering

DEGREE: Master of Science in Civil Engineering (M.S.C.E.)
Master of Science in Engineering (M.S.E.)

CONTACT: Dr. William J. Wilhelm, P.E.
Professor and Chairman of Civil Engineering
Civil Engineering Department
West Virginia University
Morgantown, West Virginia 26505
(304) 293-3867

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental engineering program of the Civil Engineering Department at West Virginia University was long oriented toward sanitary engineering and hydraulics. The program was constructed mainly between 1962 and 1967. In 1963 air pollution courses were incorporated and in 1967 solid waste courses were added. In 1976, the program was expanded with the addition of water resources courses. Because at the graduate level no rigid curriculum is prescribed for the degrees of Master of Science in Civil Engineering and Master of Science in Engineering, students may specialize in two or more specialty areas. Specialties are offered in air pollution control, solid waste management, water and wastewater treatment and water resources.

Students choosing to specialize in air pollution control and abatement are prepared to assume positions in local, state or federal regulatory agencies. Many students specializing in the water areas have found positions with industrial firms (eg. Union Carbide) or with consulting firms.

PROGRAM REQUIREMENTS

In order to enter Graduate School at West Virginia University, applicants with a baccalaureate degree, or its equivalent, from a department accredited by the Engineer's Council for Professional Development (ECPD) will be admitted on the same basis as engineering graduates of the University. If these requirements (ECPD) are not fulfilled, then the applicants must first fulfill the requirements of the department in which the advanced degree is sought.

For the Master of Science in Engineering degree, each candidate must fulfill a planned program conforming to one of the following (with the approval and discretion of the graduate committee):

(1) A minimum of 30 semester credits hours, not more than 6 of which are in research leading to an acceptable thesis.
(2) A minimum of 33 semester credit hours, nor more than 3 of which are in research leading to an acceptable problem report.
(3) A minimum of 36 semester credit hours, with no thesis or problem report required.

A thesis or problem report is normally required of all candidates and a candidate shall be required to pass an examination which may be written, oral, or both, to be administered by the student's advisory and examining committee. Depending on the program followed, the examination covers course material and the thesis or problem report.

No rigid curriculum is required for the Master of Science in Civil Engineering and Master of Science in Engineering degrees. At least fifteen semester hours credit should normally be selected from graduate civil engineering courses. Only those holding a baccalaureate degree in civil engineering are allowed to complete the requirements for the Master of Science in Civil Engineering degree. The Master of Science in Engineering degree is available to students who enter the graduate program but do not possess a baccalaureate degree in civil engineering.

Financial assistance available to graduate students enrolled in the environmental engineering program include: U.S. EPA air pollution training grants; contract research (research assistantships); one-half time teaching fellows; National Science Foundation Coal-Energy Traineeships; and West Virginia University foundation fellowships.

CURRENT FACULTY, STUDENTS, GRADUATES

Five full-time faculty members teach the bulk of the environmental engineering courses. Assistance is provided by three adjunct professors funded through the National Institute for Occupational Safety and Health. Approximately one-half of their time is devoted to teaching and one-fourth time each devotes to research and professional activities. Current research projects they are involved with include two Department of Energy (ERDA) projects and one million dollars of state money for two projects concerning air pollution control and acid mine coal drainage control.

There are currently twenty graduate students enrolled full-time in the program and all except three are male students. There are no part-time graduate students enrolled in the program. Ten students have been graduating annually in recent years in the Master's programs. Enrollment has been rather stable over the past several years.

Few graduate students enrolled in this program continue on for additional degrees. About ninety percent find employment in their field and ten percent in a related field. Recent employment trends indicate that most graduates (75 percent) find government jobs and only 25 percent find jobs in the private sector.

PROGRAM PROJECTIONS

There is not expected to be any significant growth in this program in the next several years. Expansion primarily depends on what government research is needed in the next few years. No faculty changes are also anticipated. At West Virginia University there is an attempt to develop an Environmental Health Science Program on campus. Program officials continue to foresee environmental programs continuing to be strong as long as the federal government continues to put funds into programs through research.

COURSE DESCRIPTION (SELECTED)

146 Sanitary Engineering I - Hydrology as applied to water and waste systems. (3 s.h.)

147 Sanitary Engineering II - Examination of water and waste water, water treatment, waste water treatment and special problems in public health, air pollution, and radioactivity. (3 s.h.)

251 Public Health Engineering - Engineering aspects involved in control of the environment for the protection of health and promotion of comfort of man. (3 s.h.)

252 Water Resources Engineering - Design of water resources systems. (3 s.h.)

345 Properties of Air Pollutants - Physical, chemical, biological, and social behavioral properties of dusts, droplets, and gases in the atmosphere. (3 s.h.)

349 Solid Waste Disposal - Study of traditional patterns and problems of solid waste storage, transport, and disposal. Examination of various engineering alternatives with appropriate consideration for air and water pollution control and land reclamation. (3 s.h.)

350 Sanitary Chemistry and Biology - Theory and methods of chemical analysis of water, sewage, and industrial wastes. Biological aspects of stream pollution problems. (3 s.h.)

356 Principles of Biological Waste Treatment - Examination of biological systems used in waste treatment as to ecology and function. (3 s.h.)

446 Air Pollution Control Engineering - Study of engineering alternatives in achieving various degrees of air pollution control. (3 s.h.)

447 Air Pollution Control Standards - Comparative study of technical, economical, and social factors used in developing and establishing air pollution standards, criteria, and control limitations. (3 s.h.)

452 Water Treatment Theory - Theory of various procedures and techniques utilized in treatment of water for municipal and industrial use. (3 s.h.)

454 Industrial and Advanced Waste Treatment - Basic physical and chemical operations used in industrial and advanced waste treatment; applications for waste water reclamation and reuse; study of industrial wastes from standpoint of process, source, and treatment. (3 s.h.)

455 Municipal and Industrial Design of Solid Wastes Disposal Operations - Design criteria of existing methods and equipment for disposal of solid wastes generated by industry and municipalities: on-site preparation. (3 s.h.)

457 Hydraulics of Sanitary Engineering Works - Techniques of population growth estimation, rainfall and runoff analysis, flood flow, and ground water data to the design of sanitary works. (3 s.h.)

458 Design of Sanitary Works - Water supply and waste water disposal problems. (3 s.h.)

SECTION VI - ENVIRONMENTAL ENGINEER DEGREE PROGRAMS

- Massachusetts Institute of Technology

INSTITUTION: MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROGRAM: Environmental Engineering

DEPARTMENT: Interdepartmental

DEGREE:
Environmental Engineer (Env.E.)

CONTACT: Dr. Peter S. Eagleson
Chairman, Interdepartmental Environmental
Engineer Degree Committee
School of Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139
(617) 253-2725

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental engineering at MIT is an interdisciplinary program administered by the School of Engineering and composed of faculty from the various engineering departments and from other relevant departments throughout the Institute. The program was initiated in 1973 and provides preparation in an environmentally related area of engineering and a background in the relevant area of social science, management, and law.

The degree of Environmental Engineer is a professional degree which goes beyond the Master's level but does not have the research emphasis of the doctorate. Students entering this program normally register in one of the engineering departments and plan their own programs of study which must be approved by a faculty advisor. Research facilities of the various engineering departments are used in support of the program.

PROGRAM REQUIREMENTS

Admission to the environmental engineering program is available by registering in any of the departments in the School of Engineering. General admission requirements include a bachelor's degree or equivalent from an acceptable college, university, or technical school with demonstration of an ability to accomplish a program of study and research.

The Environmental Engineer degree requires the completion of one hundred and sixty-two subject units. This includes sixty-six units in basic engineering, a minimum of twenty-five units in environmental engineering in one of three areas: air quality, water quality, or natural resource utilization, five subjects with at least forty-two units in environmental policy, up to twenty-nine units of electives and a thesis worth twenty-four units.

CURRENT FACULTY, STUDENTS, GRADUATES

Becuase of the interdepartmental structure of the program and the vast number of environmentally related subjects offered in the School of Engineering, it is impossible to tell exactly how many faculty members are involved in the program. Faculty members of the School are responsible for research as well as teaching in their primary fields. Several sources provide reaseach funding for the program, including the National Science Foundation, the National Aeronautics and Space Administration, the National Weather Service, the U. S. Geological Survey and the Rockefeller Foundation.

The program has a current enrollment of three full-time students. Most have backgrounds in civil or nuclear engineering or physics. No specific recruiting is done by the program. Many students have come from Master's programs in one of the engineering departments and become interested in environmental topics. Almost all students receive some form of financial assistance, primarily research assistantships. A few training grants and fellowships are also available.

An average of two to three students complete the program each year, and this number is expected to remain stable. Approximately fifty percent of the graduates work in the private sector, usually for consulting firms. The remainder find employment with government agencies or research work. Graduate placement is usually through students or faculty contacts with employers.

PROGRAM PROJECTIONS

No real expansion in the program or faculty is anticipated in the near future although program officials indicated that there is some need seen for an undergraduate program.

COURSE DESCRIPTION

(the following is a partial listing of courses)

1.731 Water Resources Systems I Introduction to the fundamentals of water resources systems analysis, involving the determination of the optimal dimensions, target out-puts, and operating policies of water resource projects. 9 cr.

1.77 Water Quality Control Analysis of environmental engineering problems in water quality and pollution control technology. Emphasis on predicting the distribution and fate of effluents discharged into lakes, reservoirs, rivers, estuaries, and oceans. 9 cr.

1.78 Water Quality Management Systematic approach to the management of water quality. Identification of major issues and problems areas. Type, sources, and stochastic nature of waste materials and their effect on water bodies. 9 cr.

1.811 Environmental Law: Pollution Review and analysis of common law, legialation, and regulation for pollution control. Focus on programs, analytical and decision-processes for controlling water, air, and noise pollution, and the emission of toxic materials. 9 cr.

ME 2.284 Water Purification An introduction to water resource, water quality parameters and pollutants. Outline of various water purification processes and economic considerations for water supply and wastewater treatment. 9 cr.

ChE 10.17 Air Pollution Fundamentals Introduction to the causes, effects, and control of air pollution with emphasis on combustion generated pollution and industrial process sources; origin and fate of air pollutants; air pollution meteorology; combustion processes and the formation of gaseous and particulate pollutants; air pollution control principles; measurement methods for gaseous air pollutants and for particulates. 9 cr.

Meteo 19.03 Meteorologic Aspects of Air Pollution Primary emphasis on the physical processes involved with motion and dilution of material released into the atmosphere. 9 cr.

NucE Environmental Impact Power Production An assessment of the various environmental impacts of producing thermal and electric power with currently available technology. 9 cr.

SECTION VII - NON-INSTITUTIONAL PROGRAMS

- Michigan State University
- The Ohio State University
- The Ohio State University

INSTITUTION: MICHIGAN STATE UNIVERSITY (MSU)

PROGRAM: Institute of Water Research (IWR)

DEPARTMENT:

DEGREE:

CONTACT: Mrs. Mayanne Richardson, Administrative Assistant
Institute of Water Research
334 Natural Resources Building
Michigan State University
East Lansing, Michigan 48824
(517) 353-3742

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

As the Michigan State University's Institute of Water Research brochure notes, "the legal boundaries of Michigan encompass one-third of all the fresh water in the United States." The quality of that water and other such bodies of this precious natural resource is a major concern of the Institute. Founded in 1961, IWR initially served to locate faculty members interested in and doing water research and to help them find grant support. With the 1964 Water Resources Research Act and the establishment of the Office of Water Research and Technology (OWRT) to provide institutional support to agencies like IWR, the Institute became "an action center with a capability for focusing a wide variety of research expertise on relevant environmental problems."

The IWR budget approaches one million dollars annually with monies received from OWRT, Michigan State University, industry, and private foundations. Most of these funds are used to finance water-related research projects in the state by faculty and students at Michigan State and other colleges and universities. Selection criteria for allotment grant funding include: 1) relevance of the research to Michigan water problems, 2) demonstration of professional capability on the part of the applicant, and 3) appropriateness of the design of the proposed project to the stated goals. Criteria for matching grant funding, which must be matched 50-50 with non-federal monies, allow projects that are broader in scope and related to regional and national problems. Title II grants for OWRT and other funding sources also support research conducted under the auspices of IWR.

Since 1962, nearly 70 individual projects have been undertaken with IWR aid. Without exception, all have been "relevant to the solution of water problems facing the nation, state, and world."

Projects have investigated the life processes of lakes and streams including the effect of eutrophication and thermal discharge, pollutants in water that endanger life, water quality management, and using water for practical purposes such as trickle irrigation and meteorological understanding.

Technical reports disseminated through the scientific community summarize the findings of IWR projects. Not only are these projects a source of student employment, but more than 150 graduate theses are based on IWR research. Monthly seminars during the school term (excluding summer) focus on topics related to wastewater recycling. The Institute reports that an average of over 90 persons attend each seminar. State legislators are also briefed periodically on the work at this water-research center.

A major project of the IWR has been the development and operationalization of a municipal wastewater recycling research and demonstration facility. The $2.3 million laboratory includes a portion of East Lansing's sewage treatment plant, four and a half miles of pipeline, four man-made lakes, three marshes, and a spray irrigation area. Nutrient-rich secondary effluent--2,000,000 gallons daily when operating to capacity--is pumped to the series of artificial lakes. Solar energy powers photosynthesis in the lakes and algae and rooted aquatic plants take up large amounts of nitrogen and phosphorus. Mature plants are harvested and fed to livestock or used as food supplements for other animals. Materials sifting to the lake bottoms are also removed and pumped to nearby land for use as soil conditioner and fertilizer. The water, stripped of more nutrients as it flows from one lake to the next, is expected to be of high enough quality for sport fishing and recreation by the time it reaches the fourth lake. The proximity of the project to the MSU campus allows cooperative research by scientists from botany, crop and soil sciences, economics, engineering, entomology, fisheries, forestry, horticulture, hydrology, geology, limnology, microbiology, sociology, and zoology.

The Institute coordinates its activities with a number of water-related agencies at the state, federal, and international levels. Among those agencies and units assisting in program administration are the Michigan Department of Natural Resources, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Geological Survey, U.S.-Canada International Joint Commission, Great Lakes Basin Commission, and private industry and utilities.

CURRENT FACULTY AND ADMINISTRATION AND PROGRAM PROJECTIONS

According to the 1977 Annual Report, "the Institute of Water Research, including the Director and Associate Director, now has a full-time staff of seven Ph.D. faculty, four professional staff, three technicians and three clerical office assistants. All but approximately three individuals are supported by University funds." The report notes,

> Staffing patterns . . . were shaped largely by need for technical expertise in the development of our major wastewater recycling project. In recognition of the immediate needs for technology transfer on this and related projects as well as the need to address a new generation of water resources problems, the Institute of Water Research is now undertaking an assessment of future staff priorities in light of two upcoming retirements among our faculty. The recommendations stemming from these deliberations and the style in which they are implemented will shape the direction of the Institute for the next decade. (pp. I 2-3)

The ultimate future of the Institute is dependent, of course, on a continued and increased commitment to water quality and quantity. That means more dollars must be funneled into programs such as those of the Institute for Water Research at Michigan State University.

INSTITUTION: THE OHIO STATE UNIVERSITY*

PROGRAM: Water Resources Center

DEPARTMENT:

DEGREE:

CONTACT: Dr. Robert C. Stiefel, Director
Water Resources Center
Engineering Experiment Station
Hitchcock Hall
The Ohio State University
Columbus, Ohio 43210
(614) 422-2334

PROGRAM DESCRIPTION:

Since 1964, the Water Resources Center at Ohio State University has directed and coordinated multidisciplinary research on the campus in the water resources area. The Center also serves as Ohio's Water Resources Institute charged with coordinating and administering the state's allotment and matching grant monies from the Office of Water Research and Technology (Washington, D.C.). The allotment program emphasizes water-related university research in areas of critical need in Ohio, while the matching grants support studies of regional and national interest conducted on Ohio campuses. The Center's projects support students at all levels and in institutions around the state. Through their research and related coursework, technically-skilled students leave the university well equipped to handle work in industry, regulatory agencies, consulting, or teaching.

The Water Resources Center is housed in the Engineering Experiment Station in the College of Engineering and has no permanent faculty; it considers its research staff to be "members from other faculties who are working on Water Resources Center sponsored research in their own departments." Facilities available to graduate students involved in projects include a "research and training facility shared with the Department of Civil Engineering," a "comprehensive water resources library," and "modern equipment for studies in the water resources area particularly in the field of water quality."

The Center works with the Ohio Environmental Protection Agency, Ohio Department of Natural Resources, Great Lakes Basin Commission, Ohio River Basin Commission, and indirectly with the Corps of Engineers, Soil Conservation Service, and the U.S. Geological Survey. Personnel also work with Water Research Institutes in other states "to identify regional problems and promote coordination and cooperation."

Center personnel express some concern that major funding for environmental programs should come from the Environmental Protection Agency, yet that agency's regulatory and short-term, mission-oriented research does not synchronize well with universities and colleges. Consequently, higher educational institutions stand to lose valuable research funding and training experience and support for students.

*Source: Environmental Programs and Activities at The Ohio State University, September, 1976.

INSTITUTION: THE OHIO STATE UNIVERSITY

PROGRAM: Center for Lake Erie Area Research/Franz Theodore Stone Laboratory

DEPARTMENT:

DEGREE:

CONTACT: Dr. Charles E. Herdendorf, Director
Center for Lake Erie Area Research
Franz Theodore Stone Laboratory
484 West Twelfth Avenue
Columbus, Ohio 43210
(614) 422-8949

PROGRAM DESCRIPTION:

"The Ohio State University's Lake Erie Program is devoted to the preservation, enhancement, and wise use of the lake area and its resources through innovative instruction, research, and service." The University actualizes these environmental objectives through an instructional unit - Franz Theodore Stone Laboratory- and a research unit - the Center for Lake Erie Area Research (CLEAR). In tandem, these units provide faculty and students from OSU's inland campus with a "unique blend of classroom, laboratory, and field experience."

The objectives of the Stone Laboratory (located on Gibraltar Island, Lake Erie) as enumerated in the Laboratory's Annual Report include:

(1) To provide the facilities and logistical support required for research projects on Lake Erie and its coastal zone.

(2) To promote a balanced curriculum in the aquatic and environmental sciences which utilizes the unique setting of the laboratory.

(3) To promote individual and multidisciplinary research projects which utilize the facilities and setting of the laboratory.

(4) To maintain a current library on subjects related to instructional and research topics at the laboratory.

(5) To collect baseline environmental data in the vicinity of the laboratory and maintain records of these observations.

(6) To provide facilities for workshops, seminars, and other group meetings and field trips.

(7) To serve as the public information center for information relating to Lake Erie.

(8) To preserve segments of the Lake Erie shoreline in a natural state for educational and research purposes.

As the "oldest freshwater field biological station in the country," the Stone Laboratory's instructional curriculum has served faculty and students for over eighty years. Typically, courses are administered through the College of Biological Sciences and designed to "meet the needs of graduate and advanced undergraduate biological science majors and science teachers." With planning, students may fulfill requirements for the M.S. and Ph.D. degrees in Botany and Zoology at the Laboratory. Summer coursework stresses "applied field studies in aquatic ecology and environmental biology."

The location of the Stone Laboratory on Lake Erie fosters diverse individual and group research activities. The Annual Report notes:

> Several nuclear power plants are located within 25 miles of the Laboratory which facilitate studies on the effects of thermal and chemical plumes and radiation on aquatic ecosystems. Major spawning grounds, commerical fishing fleets, and the Ohio Division of Wildlife fish hatchery at Put-in-Bay afford opportunities to study fishery problems in the Lake Erie area. The shoreline of Lake Erie and its aquatic communities are being dramatically altered by the erosive effects of record-high water levels. Man's attempts to control this phenomenon are prevalent and available for examination throughout the area. Lake Erie is well-known for its pollution problems and rapid rate of eutrophication. The Laboratory is ideally situated to provide training in the investigation of these topics.

The research wing of Ohio State University's Lake Erie program is appropriately named CLEAR (Center for Lake Erie Area Research). The Center does not grant degrees, but provides students with financial support for thesis and dissertation work. Funding for CLEAR comes from contracts and grants ($1.6 million) and the university ($50,000).

Facilities operated by CLEAR are extensive. In addition to campus laboratories, there are laboratories, classroom and housing facilities on South Bass Island, on the Huron River near Huron, Ohio, and in Toledo, Ohio. The Research Building on South Bass Island "features an analytic chemistry laboratory, a dark room, a thermal gradient unit for studying thermal effects on fish, and holding tanks for collected aquatic organisms." Other facilities include "a radiation counting laboratory," "a water quality laboratory," and "a mobile laboratory to facilitate several research projects being conducted in Maumee bay." The Center also operates several vessels for use on the Lake. One, which is currently leased from the Environmental Protection Agency, "contains an analytical chemistry laboratory and accommondations for an operating and scientific crew of eight. Onboard analytical equipment includes an auto-analyzer a gas chromatograph, a spectrophotometer, a submersible pump, vacuum filtration units, and probe instrumentation for direct measurement of several physical/chemical parameters of water quality." Another research vessel is "used for trawling, coring, dredging, and other limnological studies." There are also boats for light field work.

Examples of recent work supported by CLEAR include: "(1) food resources from the lake, (2) impact of the energy crisis, (3) coastal zone management and erosion control, and (4) pollution and eutrophication." Off-campus research funds have come from "the U.S. Fish and Wildlife Service; U.S.E.P.A.; U.S. Department of the Army, Corps of Engineers; U.S. Department of the Interior, Office of Water Research and Technology, National Park Service; Ohio Department of Natural Resources, Division of Wildlife, Division of Geological Survey and Division of Research; Office of the Ohio Attorney General; National Science Foundation; National Oceanic and Atmospheric Administration; International Association for Great Lakes Research; International Joint Commission and Great Lakes Basic Commission; State University of New York Sea Grant Program; American Electric Power Service Corporation, Ohio Power Company; Toledo Edison Company and Cleveland Electric Illuminating Company; Ohio Edison Company and Woodward Gardner Company; Dalton, Dalton, Little & Newport; Magnavox Company; White Bros. Sand, Inc.; and Gilbert Associates, Inc.

The Lake Erie research program on the Ohio State campus and the islands of the Lake seeks to produce informed young scientists capable of making pragmatic decisions. Through the Stone Laboratory and CLEAR, the University is continually upgrading it academic and research efforts in this crucial environmental area--the quality of our lakes.

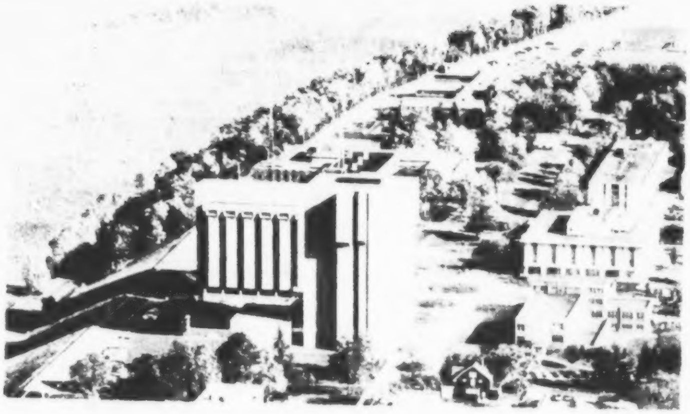

Photo reprinted from the Michigan Technological University Catalog 1975-76

APPENDICES

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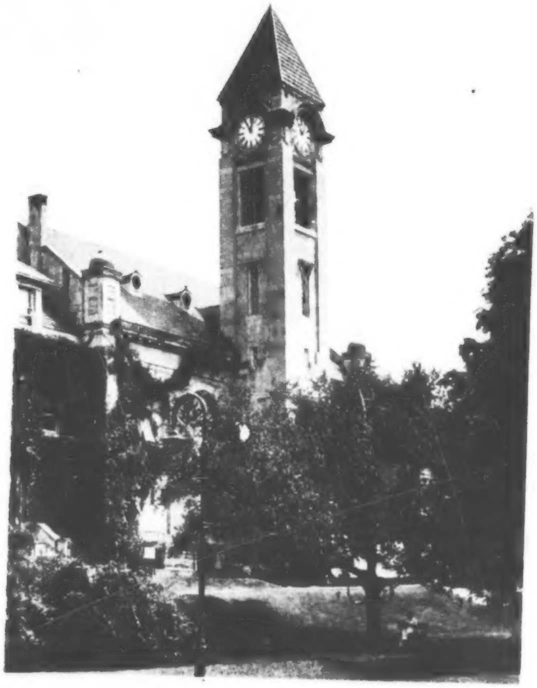


Photo reprinted from the Indiana University of Public and Environmental Affairs Catalog 1977-78

I

APPENDIX I

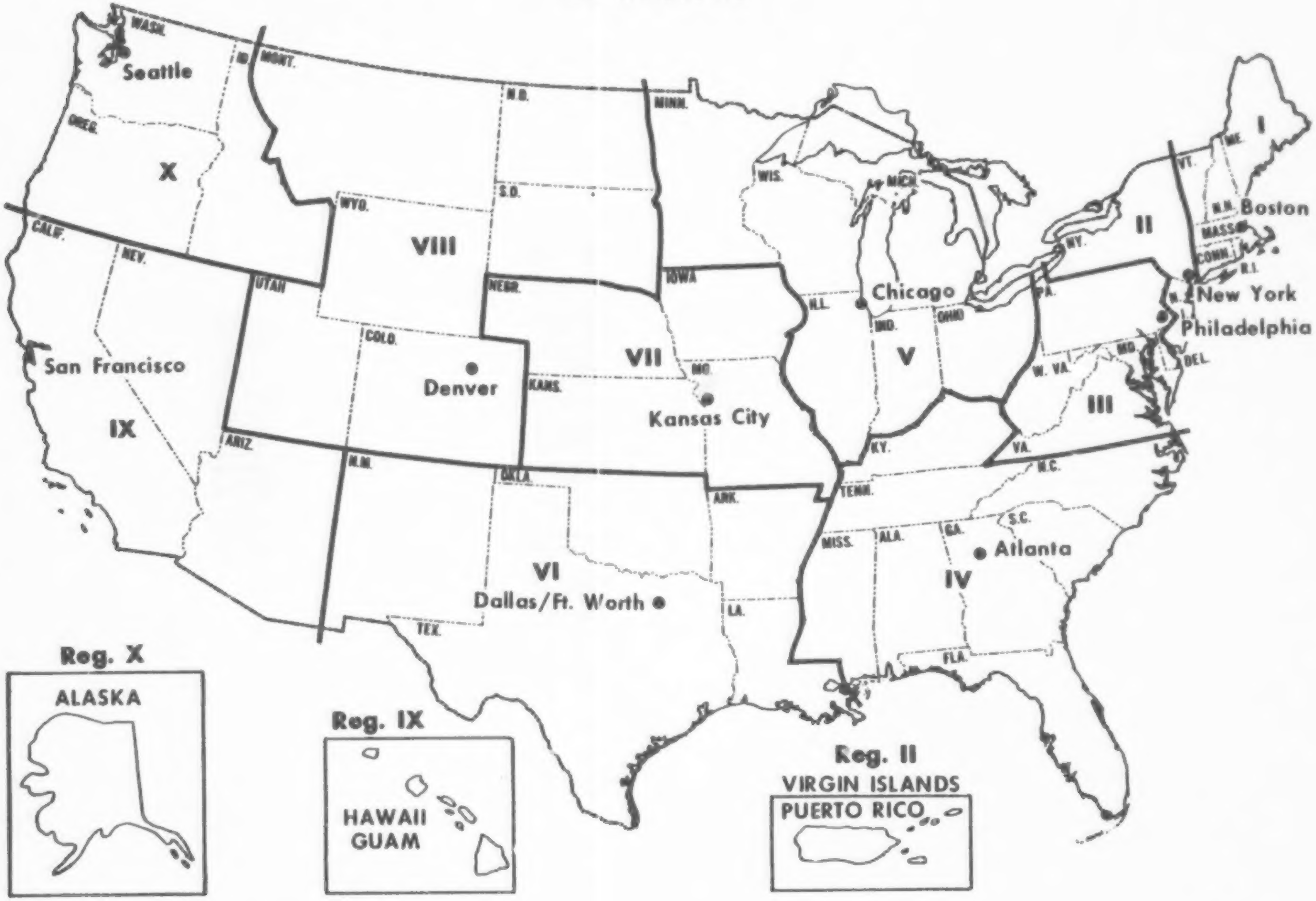
Degree Abbreviations

A.A.	Associate of Arts
A.A.Ag.	Associate of (in) Applied Agriculture
A.Ag.	Associate of (in) Agriculture
A.A.P.C.T.	Associate Degree in Air Pollution Control Technology
A.A.S.	Associate of Applied Science
A.B.	Bachelor of Arts
A.D.	Associate Degree
A.E.T.	Associate in Engineering Technology
A.M.T.	Associate of Mining Technology
A.N.E.T.	Associate of Nuclear Engineering Technology
A.S.	Associate in Science
A.S.E.M.T.	Associate of Science in Engineering Mining Technology
A.T.	Associate of Technology
B.A.	Bachelor of Arts
B.E.M.T.	Bachelor of Engineering in Mining Technology
B.S.	Bachelor of Science
B.S. (N.E.)	Bachelor of Science in Nuclear Engineering
B.S. (N.E.S.)	Bachelor of Science (Nuclear Engineering Sciences)
B.S. (N.R.)	Bachelor of Science in Natural Resources
B.S.A.	Bachelor of Science in Agriculture
B.S.C.E.	Bachelor of Science in Civil Engineering
B.S.Ch.E.	Bachelor of Science in Chemical Engineering
B.S.E.	Bachelor of Science in Engineering
B.S.E.H.	Bachelor of Science in Environmental Health
B.S.E. (N.E.)	Bachelor of Science (Nuclear Engineering)
B.S.E.S.	Bachelor of Science in Engineering Sciences
B.S.N.E.	Bachelor of Science in Nuclear Engineering
B.T.	Bachelor of Technology
Cert.	Certificate

D.E.	Doctor of Engineering
D.P.H.	Doctor of Public Health
D.S.	Doctor of Science
D.S. (Hyg.)	Doctor of Science Hygiene
D.Sc.	Doctor of Science
Dr.P.H.	Doctor of Public Health
E.E.	Environmental Engineer
Eng.	Engineer
Engr.	Engineer
Engr.Sc.D.	Doctor of Engineering Science
Env.E.	Environmental Engineer
Envir.Eng.	Environmental Engineer
M.A.	Master of Arts
M.Ag.	Master of Agriculture
M.Agr.	Master of Agriculture
M.A.S.	Master of Applied Science
M.C.E.	Master of Civil Engineering
M.E.	Master of Engineering
M.E.E.E.	Master of Engineering in Environmental Engineering
M.E.A.S.	Master of Environmental Arts and Science
M.E.H.S.	Master of Environmental Health Sciences
M.E.M.	Master of Environmental Management
M.E.P.C.	Master in Environmental Pollution Control
M.Eng.	Master of Engineering
M.Engr.	Master of Engineering
M.F.	Master of Forestry
M.M.E.	Master of Mechanical Engineering
M.P.	Master of Philosophy
M.P.A.	Master of Public Affairs
M.P.H.	Master of Public Health
M.P.P.P.M.	Master of Plant Protection and Pest Management

M.P.S.	Master of Professional Studies
M.S.	Master of Science
M.S. (Hyg.)	Master of Science Hygiene
M.S.C.E.	Master of Science in Civil Engineering
M.S.Ch.E.	Master of Science in Chemical Engineering
M.S.E.	Master of Science in Engineering
M.S.E.E.	Master of Science in Environmental Engineering
M.S.En.E.	Master of Science in Environmental Engineering
M.S.Eng. S.	Master of Science in Environmental Engineering
M.S.Eng. Sci.	Master of Science in Engineering Science
M.S.E.H.	Master of Science in Environmental Health
M.S.E.M.P.	Master of Science in Energy Management and Policy
M.S.E.S.	Master of Science in Environmental Science (Studies)
M.S.P.H.	Master of Science in Public Health
M.S.(S.E.)	Master of Science in Sanitary Engineering
M.S.(S.S.)	Master of Science in Sanitary Science
N.E.	Nuclear Engineering
Nuc. Eng.	Nuclear Engineering
Ph.D.	Doctor of Philosophy
S.B.	Bachelor of Science
Sc.D.	Doctor of Science
S.M.	Master of Science

STANDARD REGIONAL BOUNDARIES
TEN REGIONS



II

TERMINOLOGY

ACT (American College Testing) and SAT (Scholastic Aptitude Test) - Standardized examinations which are intended to provide applicants and institutions with a numerical statement of an individual's ability and readiness to successfully complete college/university level work.

Co-op program - A plan whereby a student receives financial assistance and academic credit under the direction of a cooperating employment site representative and a faculty advisor in exchange for an agreed upon condition of employment. Students must complete all degree requirements as per the norm.

Course - For the purpose of this study, a course is considered a unit of a program, in which a body of knowledge is presented, the satisfactory completion of which leads to the awarding of a predetermined or individually arranged number of credits.

ECPD (Engineers' Council for Professional Development) - Accrediting body for programs in engineering technology.

ERIC (Educational Resources Information Center) - A national information system designed and developed by the U.S. Office of Education, and now supported and operated by the National Institute of Education (NIE), for providing ready access to descriptions of exemplary programs, research and development efforts, and related information that can be used in developing more effective educational programs.

GRE (Graduate Record Examination) - (General Aptitude) An examination of verbal and mathematical competency and aptitude, which is designed to provide a numerical indication of an individual's ability to successfully complete advanced level work. For the purposes of the study, the GRE will not refer to the Advanced Examinations.

Internship/Applied Study Term - An arrangement which is intended to provide a simulation of work experience under the direction of academic advisors and is designed to be an integral segment of an individual's academic program. (College credit may be given.)

IRIS (Instructional Resources Information System) - A computerized information base listing materials relating to education and training in the water quality control field, which is located in the National Training and Operational Technology Center of the U.S. Environmental Protection Agency.

MEDLINE - Computerized literature search services with application to medical information.

NTIS (National Technical Information Service) - Computerized literature search services.

Program - For the purpose of this study, a plan of study, either completely prescribed, or containing options, with an identity of its own, and standard rules and procedures, the satisfaction of which may lead to a degree, certificate, or diploma.

Quarter hours - vs. - Semester hours - One semester hour is the credit equivalent to one and a half quarter hours.

Standard Federal Boundaries - Geographic division of the United States for the purposes of decentralized administration; in this report also referred to as EPA regions (see map on preceding page).

TOXLINE - Computerized literature search services with particular application to the recall of information concerning toxic substances.

WRSIC (Water Resources Scientific Information Center) - Collects, screens, organizes and disseminates reports in water resources.

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APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
AIR	Carnegie-Mellon University	Pittsburgh, PA
	Clemson University	Clemson, SC
	Drexel University	Philadelphia, PA
	George Washington University-NASA	Hampton, VA
	Harvard University School of Public Health	Boston, MA
	Hudson Valley Community College	Troy, NY
	Massachusetts Institute of Technology	Ithaca, NY
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Chapel Hill, NC
	North Dakota State School of Science	Wahpeton, ND
	Northeastern University	Boston, MA
	Ohio State University	Columbus, OH
	Portland State University	Portland, OR
	Prairie State Community College	Chicago Heights, IL
	Purdue University	West Layfayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers-The State University of New Jersey	New Brunswick, NJ
	Springfield Technical Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Sumter University	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Iowa	Iowa City, IA
	University of Kentucky	Lexington, KY
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of Missouri-Rolla	Rolla, MO
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Washington	Seattle, WA
	University of Wisconsin-Milwaukee	Milwaukee, WI
	Vanderbilt University	Nashville, TN
	Washington State University	Pullman, WA
	Washington University	St. Louis, MO
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE:	Antioch College	Yellow Springs, OH
	Baylor University	Waco, TX
	Bemidji State University	Bemidji, MN
	California Institute of Technology	Pasadena, CA
	California Polytechnic State University	San Luis Obispo, CA
	Catholic University of America	Washington, DC
	Carnegie-Mellon University	Pittsburgh, PA
	Chattanooga State Technical Community College	Chattanooga, TN
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Cornell University	Ithaca, NY
	Delaware Technical and Community College	Newark, DE
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	Duke University	Durham, NC
	East Central Oklahoma State University	Ada, OK
	East Tennessee State University	Johnson City, TN
	Evergreen State College	Olympia, WA
	Ferris State College	Big Rapids, MI
	Florida International University	Miami, FL
	Georgia Institute of Technology	Atlanta, GA
	Heed University	Hollywood, FL
	Hocking Technical College	Nelsonville, OH
	Howard University	Washington, DC
	Hunter College	New York, NY
	Indiana University	Bloomington, IN
	Iowa State University	Ames, IA
	Johns Hopkins University	Baltimore, MD
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Lamar University	Beaumont, TX
	Macalester College	St. Paul, MN
	Massachusetts Institute of Technology	Cambridge, MA
	McNeese State University	Lake Charles, LA
	Miami University	Oxford, OH
	Michigan State University	East Lansing, MI
	Middle Tennessee State University	Murfreesboro, TN
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	New Jersey Institute of Technology	Newark, NJ
	North Carolina State University	Raleigh, NC
	Northland College	Ashland, WI
	Ohio State University	Columbus, OH

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE: (Cont'd)	Ohio University	Athens, OH
	Oscar Rose Junior College	Midwest City, OK
	OSU Oklahoma City Technical Institute	Oklahoma City, OK
	Polytechnical Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Raymond Walters General and Technical College (University of Cincinnati	Cincinnati, OH
	Rensselaer Polytechnical Institute	Troy, NY
	Rutgers University	New Brunswick, NJ
	Sam Houston State University	Huntsville, TX
	Sangamon State University	Springfield, IL
	Slippery Rock State College	Slippery Rock, PA
	Springfield Technical and Community College	Springfield, MA
	Stevens Institute of Technology	Hoboken, NJ
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas A & M University	College Station, TX
	The Cooper Union	New York, NY
	The Pennsylvania State University	University Park, PA
	University of Alabama	University, AL
	University of Alaska	Fairbanks, AK
	University of Arkansas	Fayetteville, AR
	University of California-Santa Barbara	Santa Barbara, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Florida	Gainesville, FL
	University of Georgia	Athens, GA
	University of Kansas	Lawrence, KS
	University of Louisville	Louisville, KY
	University of Maine-Orono	Orono, Maine
	University of Michigan	Ann Arbor, MI
	University of Minnesota	Minneapolis, MN
	University of North Carolina	Chapel Hill, NC
	University of Oklahoma	Norman, OK
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Toledo	Toledo, OH
	University of Utah	Salt Lake City, UT
	University of Washington	Seattle, WA
	University of Wisconsin-Green Bay	Green Bay, WI
	University of Wisconsin-Madison	Madison, WI
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
COMPOSITE: (Cont'd)	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Washington State University	Pullman, WA
	Western Kentucky University	Bowling Green, KY
	Western Washington University (Huxley College of Environmental Studies)	Bellingham, WA
	West Virginia University	Morgantown, WV
	Yale University	New Haven, CT
ENERGY:	Bluefield State College	Bluefield, WV
	Brigham Young University	Provo, UT
	Carnegie-Mellon University	Pittsburgh, PA
	Columbia University	New York, NY
	Cornell University	New York, NY
	Georgia Institute of Technology	Atlanta, GA
	Hartford State Technical College	Hartford, CT
	Kansas State University	Manhattan, KS
	Lamar University	Beaumont, TX
	Massachusetts Institute of Technology	Cambridge, MA
	Morehead State University	Morehead, KY
	Muskingum Area Technical College	Zanesville, OH
	Oregon State University	Corvallis, OR
	Pikeville College	Pikeville, KY
	Polytechnic Institute of New York	Brooklyn, NY
	Princeton University	Princeton, NJ
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Southern Technical Institute	Marietta, GA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Kentucky	Lexington, KY
	University of New Mexico	Albuquerque, NM
	University of Pennsylvania	Philadelphia, PA
	University of Tennessee	Knoxville, TN
	West Virginia Institute of Technology	Montgomery, WV
	West Virginia University	Morgantown, WV

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
NOISE:	George Washington University-NASA	Hampton, VA
	Georgia Institute of Technology	Altanta, GA
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	North Carolina State University	Raleigh, NC
	The Pennsylvania State University	University Park, PA
	University of Cincinnati	Cincinnati, OH
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
	University of Tennessee Center for Health Sciences	Memphis, TN
PESTICIDES:	Abraham Baldwin Agricultural College	Tifton, GA
	Broward Community College	Ft. Lauderdale, FL
	Central Technical Community College	Hastings, NE
	Delgado Community College	New Orleans, LA
	Harvard University School of Public Health	Boston, MA
	Mississippi State University	Mississippi State, MS
	New Mexico State University	Las Cruces, NM
	North Carolina State University	Raleigh, NC
	Ohio State University	Columbus, OH
	Oregon State University	Corvallis, OR
	Rutgers State University of New Jersey	New Brunswick, NJ
	State University of New York at Farmingdale	Farmingdale, NY
	Texas A & M University	College Station, TX
	The Pennsylvania State University	University Park, PA
	University of California-Berkeley	Berkeley, CA
	University of California-Davis	Davis, CA
	University of California-Riverside	Riverside, CA
	University of Cincinnati	Cincinnati, OH
	University of Delaware	Newark, DE
	University of Georgia	Athens, GA
	University of Iowa	Iowa City, IA
	University of Maryland	College Park, MD
	University of New Hampshire	Durham, NH
	University of Pittsburgh	Pittsburgh, PA
	University of Rochester	Rochester, NY
	Utah State University	Logan, UT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
POTABLE WATER:	Atlanta University Center/Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex Community College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK
	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester Institute of Technology	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
POTABLE WATER: (Cont'd)	Springfield Technical Community College	Springfield, MA
	Stanford University	Stanford, CA
	State University of New York at Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu, HI
	University of Iowa	Iowa City, IA
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Maine at Orono	Orono, ME
	University of Michigan	Ann Arbor, MI
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pennsylvania	Philadelphia, PA
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas-Austin	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
RADIATION:	Central Florida Community College	Ocala, FL
	Chattanooga State Technical Community College	Chattanooga, TN
	Columbia University	New York, NY
	Cornell University	Ithaca, NY
	Hartford State Technical College	Hartford, CT
	Harvard University School of Public Health	Boston, MA
	Kansas State University	Manhattan, KS
	Massachusetts Institute of Technology	Cambridge, MA
	Memphis State University	Memphis, TN
	Missouri Southern State College	Joplin, MO
	Oak Ridge Associated Universities	Oak Ridge, TN
	Oklahoma State University	Stillwater, OK
	Rensselaer Polytechnic Institute	Troy, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	St. Louis Community College at Forest Park	St. Louis, MO
	Southern Technical Institute	Marietta, GA
	The Pennsylvania State University	University Park, PA
	University of Florida	Gainesville, FL
	University of Kansas	Lawrence, KS
	University of Lowell	Lowell, MA
	University of Maryland	College Park, MD
	University of Michigan	Ann Arbor, MI
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Tennessee	Knoxville, TN
SOLID WASTE:	Carnegie-Mellon University	Pittsburgh, PA
	Clarkson College	Potsdam, NY
	Cornell University	New York, NY
	Drexel University	Philadelphia, PA
	Hofstra University	Hempstead, NY
	Michigan Technological University	Houghton, MI
	Rensselaer Polytechnic Institute	Troy, NY
	Temple University	Philadelphia, PA
	The Pennsylvania State University	University Park, PA
	University of Iowa	Iowa City, IA
	University of Missouri-Rolla	Rolla, MO
	University of Pittsburgh	Pittsburgh, PA
	Vanderbilt University	Nashville, TN
	West Virginia University	Morgantown, WV
	Wilson County Technical Institute	Wilson, NC
	Yale University	New Haven, CT

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
WASTEWATER:	Atlanta University Center/ Georgia Institute of Technology	Atlanta, GA
	Brigham Young University	Provo, UT
	California State University-Sacramento	Sacramento, CA
	Carnegie-Mellon University	Pittsburgh, PA
	Casper College	Casper, WY
	Central Technical Community College	Hastings, NE
	Charles County Community College	La Plata, MD
	Clarkson College	Potsdam, NY
	Clemson University	Clemson, SC
	Colorado State University	Fort Collins, CO
	Community College of Denver-Red Rocks	Golden, CO
	Cornell University	Ithaca, NY
	Delgado College	New Orleans, LA
	Drexel University	Philadelphia, PA
	East Maine Vocational Technical Institute	Bangor, ME
	Greenville Technical College	Greenville, SC
	Harvard University	Cambridge, MA
	Hudson Valley Community College	Troy, NY
	Illinois Institute of Technology	Chicago, IL
	Iowa State University	Ames, IA
	J. Sargeant Reynolds Community College	Richmond, VA
	Kansas State University	Manhattan, KS
	Kirkwood Community College	Cedar Rapids, IA
	Linn-Benton Community College	Albany, OR
	Manhattan College	New York, NY
	Marquette Technical University	Milwaukee, WI
	Massachusetts Institute of Technology	Cambridge, MA
	Miami-Dade Community College	Miami, FL
	Michigan Technological University	Houghton, MI
	Middlesex County College	Edison, NJ
	Missouri Southern State College	Joplin, MO
	Montana State University	Bozeman, MT
	Muskingum Area Technical College	Zanesville, OH
	New England Regional Wastewater Institute	S. Portland, ME
	New Jersey Institute of Technology	Newark, NJ
	Northeastern University	Boston, MA
	Northern Montana College	Havre, MT
	Ohio State University	Columbus, OH
	Operator Training Center	Murfreesboro, TN
	Oregon Institute of Technology	Klamath Falls, OR
	Oscar Rose Junior College	Midwest City, OK

APPENDIX IV

PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY

CATEGORY	INSTITUTION	LOCATION
WASTEWATER: (Cont'd)	Purdue University	West Lafayette, IN
	Rensselaer Polytechnic Institute	Troy, NY
	Rice University	Houston, TX
	Rochester University	Rochester, NY
	Rutgers State University of New Jersey	New Brunswick, NJ
	Southern Illinois University	Edwardsville, IL
	Springfield Technical and Community College	Springfield, MA
	Stanford University	Stanford, CA
	State Technical Institute at Memphis	Memphis, TN
	State University of New York-Buffalo	Buffalo, NY
	Stevens Institute of Technology	Hoboken, NJ
	Sumter Technical Community College	Sumter, SC
	Syracuse University	Syracuse, NY
	Temple University	Philadelphia, PA
	Texas State Technical Institute	Waco, TX
	The Pennsylvania State University	University Park, PA
	The Pennsylvania State University/ Capitol Campus	Middletown, PA
	Tufts University	Boston, MA
	Ulster County Community College	Stone Ridge, NY
	University of California-Berkeley	Berkeley, CA
	University of Florida	Gainesville, FL
	University of Hawaii	Honolulu HI
	University of Kansas	Lawrence, KS
	University of Kentucky	Lexington, KY
	University of Lowell	Lowell, MA
	University of Maine at Orono	Orono, ME
	University of Missouri-Columbia	Columbia, MO
	University of Missouri-Rolla	Rolla, MO
	University of Nebraska	Lincoln, NE
	University of North Carolina	Chapel Hill, NC
	University of Pittsburgh	Pittsburgh, PA
	University of Rhode Island	Kingston, RI
	University of Tennessee	Knoxville, TN
	University of Texas	Austin, TX
	University of Wisconsin-Madison	Madison, WI
	University of Wyoming	Laramie, WY
	Utah State University	Logan, UT
	Vanderbilt University	Nashville, TN
	Virginia Polytechnic Institute and State University	Blacksburg, VA
	Water and Wastewater Technical School	Neosho, MO
	West Georgia College	Carrollton, GA
	West Virginia University	Morgantown, WV
	Wytheville Community College	Wytheville, VA

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
AL	Alabama A & M University	Huntsville
	Alabama Christian College	Montgomery
	Alabama Lutheran Junior College	Selma
	Alexander City State Junior College	Alexander City
	Athens State College	Athens
	Auburn University	Auburn
	Auburn University at Montgomery	Montgomery
	Birmingham-Southern College	Birmingham
	Brewer State Junior College	Fayette
	Enterprise State Junior College	Enterprise
	Faulkner State Junior College	Bay Minette
	Gadsden State Junior College	Gadsden
	George C. Wallace State Community College	Dothan
	George C. Wallace State Community College	Selma
	Jacksonville State University	Jacksonville
	Jefferson Davis State Junior College	Brewton
	Jefferson State Junior College	Birmingham
	John C. Calhoun State Community College	Decatur
	Judson College	Marion
	Livingston University	Livingston
	Lawson State Community College	Birmingham
	Lurleen B. Wallace State Junior College	Andalusia
	Marion Military Institute	Marion
	Miles College	Birmingham
	Mobile College	Mobile
	Northeast Alabama State Junior College	Rainsville
	Northwest Alabama State Junior College	Phil Campbell
	Oakwood College	Huntsville
	Samford University	Birmingham
	Selma University	Selma
	Snead State Junior College	Boaz
	Southeastern Bible College	Birmingham
	Southern Benedictine College	Saint Bernard
	Southern Union State Junior College	Wadley
	Spring Hill College	Mobile
	Stillman College	Tuscaloosa
	Talladega College	Talladega
	Troy State University	Troy
	Tuskeegee Institute	Tuskeegee Institute
	University of Alabama	University
	University of Alabama in Birmingham	Birmingham
	University of Alabama in Huntsville	Huntsville
	University of Montevallo	Montevallo
	University of North Alabama	Florence
	University of South Alabama	Mobile
	Walker College	Jasper
AK	Sheldon Jackson College	Sitka
	University of Alaska-Fairbanks	Fairbanks
	University of Alaska Juneau Senior College	Juneau
AS	American Samoa Community College	Pago Pago
AZ	American Graduate School of International Management	Glendale
	Arizona State University	Tempe
	Arizona Western College	Yuma

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Central Arizona College	Coolidge
	Cochise College	Douglas
	College of Ganado	Ganado
	DeVry Institute of Technology	Phoenix
	Eastern Arizona College	Thatcher
	Grand Canyon College	Phoenix
	Maricopa County Community	
	College System Office	Phoenix
	Glendale Community College	Glendale
	Maricopa Technical Community College	Phoenix
	Mesa Community College	Mesa
	Phoenix College	Phoenix
	Scottsdale Community College	Scottsdale
	Mohave Community College	Kingman
	Navajo Community College	Tsaile
	Northern Arizona University	Flagstaff
	Northland Pioneer College	Holbrook
	Pima Community College	Tucson
	Southwestern College	Phoenix
	University of Arizona	Tucson
	Yavapai College	Prescott
AR	Arkansas College	Batesville
	Arkansas State University-Main Campus	State University
	Arkansas State University-Beebe Branch	Beebe
	Arkansas Tech University	Russellville
	Central Baptist College	Conway
	College of the Ozarks	Clarksville
	Crowley's Ridge College	Paragould
	Garland County Community College	Hot Springs
	Harding College-Main Campus	Searcy
	Henderson State University	Arkadelphia
	Hendrix College	Conway
	John Brown University	Siloam Springs
	Mississippi County Community College	Blytheville
	Quachita Baptist University	Arkadelphia
	Philander Smith College	Little Rock
	Phillips County Community College	Helena
	Southern Arkansas University	Magnolia
	Southern Arkansas University Southwest Technical Institute	East Camden
	Southern Baptist College	Walnut Ridge
	Southern State College	Magnolia
	University of Arkansas-Main Campus	Fayetteville
	University of Arkansas-Little Rock	Little Rock
	University of Arkansas Medical Sciences Campus	Little Rock
	University of Arkansas-Monticello	Monticello
	Westlark Community College	Fort Smith
CA	Allan Hancock College	Santa Maria
	Ambassador College	Pasadena
	American Baptist Seminary of the West-Central Office	Berkeley
	American Baptist Seminary of the West-Covina	Covina
	Armstrong College	Berkeley
	Azusa Pacific College	Azusa
	Bakersfield College	Bakersfield
	Barstow College	Barstow
	Bauder College	Sacramento
	Bethany Bible College	Santa Cruz
	Biola College	La Mirada
	Brooks College	Long Beach

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Brooks Institute of Santa Barbara	Santa Barbara
	Butte College	Oroville
	Cabrillo College	Aptos
	California Baptist College	Riverside
	California College of Arts and Crafts	Oakland
	California Institute of the Arts	Valencia
	California Institute of Asian Studies	San Francisco
	California Institute of Technology	Pasadena
	California Lutheran College	Thousand Oaks
	California Maritime Academy	Vallejo
	California State College-San Bernadino	San Bernardino
	California State College-Stanislaus	Turlock
	California Polytechnic State University-San Luis Obispo	San Luis Obispo
	California State University-Fresno	Fresno
	California State University-Fullerton	Fullerton
	California State University-Hayward	Hayward
	California State University-Long Beach	Long Beach
	California State University-Los Angeles	Los Angeles
	California State University-Sacramento	Sacramento
	San Diego State University	San Diego
	San Jose State University	San Jose
	Cerritos College	Norwalk
	Cerro Coso Community College	Ridgecrest
	Chapman College	Orange
	Christian Heritage College	El Cajon
	Church Divinity School of the Pacific	Berkeley
	Citrus College	Azusa
	Claremont Colleges-System Office	Claremont
	Claremont Men's College	Claremont
	Claremont University Center and Graduate School	Claremont
	Harvey Mudd College	Claremont
	Pitzer College	Claremont
	Pomona College	Claremont
	Scripps College	Claremont
	Coast Community College-System Office	Costa Mesa
	Golden West College	Huntington Beach
	Orange Coast College	Costa Mesa
	Cogswell College	San Francisco
	Colegio De La Tierra	Goshen
	College of the Canyons	Valencia
	College of the Desert	Palm Desert
	College of Marin	Kentfield
	College of Notre Dame	Belmont
	College of the Redwoods	Eureka
	College of the Siskiyous	Weed
	Columbia Junior College	Columbia
	Compton Community College	Compton
	Contra Costa Community College-System Office	
	Diablo Valley College	Pleasant Hill
	Cuesta College	San Luis Obispo
	Cypress College	Cypress
	Dominican College of San Rafael	San Rafael
	El Camino College	Torrance
	Foothill-De Anza Community College District-System Office	Los Altos Hills
	De Anza College	Cupertino
	Foothill College	Los Altos Hills
	Fuller Theological Seminary	Pasadena
	Gavilan College	Gilroy
	Glendale Community College	Glendale
	Golden Gate University	San Francisco
	Grossmont College	El Cajon
	Hartnell College	Salinas
	Holy Family College	Mission San Jose

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Holy Names College	Oakland
	Immaculate Heart College	Los Angeles
	Indian Valley Colleges	Novato
	John F. Kennedy University	Orinda
	Lake Tahoe Community College	S. Lake Tahoe
	Lassen College	Susanville
	LaVerne College	La Verne
	L.I.F.E. Bible College	Los Angeles
	Lincoln University	San Francisco
	Lone Mountain College	San Francisco
	Long Beach City College	Long Beach
	Los Angeles Baptist College	Newhall
	Los Angeles Community College-	
	System Office	Los Angeles
	East Los Angeles College	Los Angeles
	Los Angeles City College	Los Angeles
	Los Angeles Harbor College	Wilmington
	Los Angeles Mission College	San Fernando
	Los Angeles Pierce College	Woodland Hills
	Los Angeles Southwest College	Los Angeles
	Los Angeles Valley College	Van Nuys
	West Los Angeles College	Culver City
	Los Rios Community College-	
	System Office	Sacramento
	Cosumnes River College	Sacramento
	Sacramento City College	Sacramento
	Loyla Marymount University	Los Angeles
	Marymount Palos Verdes College	Rancho Palos Verdes
	Mendocino College	Ukiah
	Menlo College	Menlo Park
	Mennonite Brethren Biblical Seminary	Fresno
	Merced College	Merced
	Mills College	Oakland
	Monterey Institute for Foreign Studies	Monterey
	Monterey Peninsula College	Monterey
	Mount San Antonio College	Walnut
	Mount San Jacinto College	San Jacinto
	Napa College	Napa
	National University	San Diego
	New College of California	San Francisco
	Northrop University	Inglewood
	Occidental College	Los Angeles
	Ohlone College	Fremont
	Otis Art Institute of Los Angeles County	Los Angeles
	Pacific Christian College	Fullerton
	Pacific College	Fresno
	Pacific Oaks College	Pasadena
	Pacific School of Religion	Berkeley
	Pacific Union College	Angwin
	Palomar College	San Marcos
	Palo Verde College	Blythe
	Pasadena City College	Pasadena
	Patten Bible College	Oakland
	Pepperdine University	Malibu
	Peralta Community Colleges-System Office	Oakland
	College of Alameda	Alameda
	Point Loma College	San Diego
	Porterville College	Porterville
	Rand Graduate Institute of Policy Studies	Santa Monica
	Riverside City College	Riverside
	Rosemead Graduate School of Psychology	Rosemead
	Saddleback Community College	Mission Viejo
	Saint Mary's College of California	Moraga

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Saint Patrick's College	Mountain View
	San Diego Community College-Central Office	San Diego
	San Diego Community College-City College	San Diego
	San Diego Community College-Evening College	
	San Francisco Art Institute	San Francisco
	San Francisco Conservatory of Music	San Francisco
	San Francisco Theological Seminary	San Anselmo
	San Joaquin Delta College	Stockton
	San Jose Community College District-	
	Evergreen Valley College	San Jose
	San Jose City College	San Jose
	San Mateo County Community College District-System Office	San Mateo
	Canada College	Redwood City
	College of San Mateo	San Mateo
	Skyline College	San Bruno
	Santa Ana College	Santa Ana
	Santa Barbara City College	Santa Barbara
	Santa Monica College	Santa Monica
	Santa Rosa Junior College	Santa Rosa
	Shasta College	Redding
	Sierra College	Rocklin
	Simpson College	San Francisco
	Solano Community College	Suisun City
	Southern California College	Costa Mesa
	Southern California College of Optometry	Fullerton
	Southwestern University School of Law	Los Angeles
	Stanford University	Stanford
	State Center Community College District	
	Fresno City College	Fresno
	Reedley College	Reedley
	Taft College	Taft
	United States International University	San Diego
	University of California-Berkeley	Berkeley
	University of California-Davis	Davis
	University of California Hastings College of Law	San Francisco
	University of California-Irvine	Irvine
	University of California-Los Angeles	Los Angeles
	University of California-Riverside	Riverside
	University of California-San Francisco	San Francisco
	University of California-Santa Barbara	Santa Barbara
	University of the Pacific	Stockton
	University of Redlands	Redlands
	University of San Diego	San Diego
	University of San Francisco	San Francisco
	University of Santa Clara	Santa Clara
	University of Southern California	Los Angeles
	University of West Los Angeles	Culver City
	Ventura County Community College District	
	Moorpark College	Moorpark
	Oxnard College	Oxnard
	Ventura College	Ventura
	West Coast Bible College	Fresno
	West Coast University Central Office	Los Angeles
	West Coast University Orange County Center	Orange
	Western State University College of Law-Orange County	Fullerton
	Western State University College of Law-San Diego	San Diego
	West Hills College	Coalinga
	Westmont College	Santa Barbara
	West Valley College	Saratoga

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Whittier College	Whittier
	Woodbury University	Los Angeles
	The Wright Institute	Berkeley
	Yuba College	Marysville
CO	Adams State College	Alamosa
	Aims Community College	Greeley
	Arapahoe Community College	Littleton
	Colorado College	Colorado Springs
	Colorado Mountain College-East Campus	Leadville
	Colorado Mountain College-West Campus	Glenwood Springs
	Colorado School of Mines	Golden
	Colorado State University	Fort Collins
	Colorado Technical College	Manitou Springs
	Colorado Women's College	Denver
	Community College of Denver-Auraria Campus	Denver
	Community College of Denver-North Campus	Denver
	Community College of Denver-Red Rocks Campus	Golden
	Conservative Baptist Theological Seminary	Denver
	El Paso Community College	Colorado Springs
	Fort Lewis College	Durango
	Iliff School of Theology	Denver
	Lamar Community College	Lamar
	Loretto Heights College	Denver
	Mesa College	Grand Junction
	Metropolitan State College	Denver
	Morgan Community College	Fort Morgan
	Northeastern Junior College	Sterling
	Ortero Junior College	La Junta
	Regis College	Denver
	Rockmont College	Denver
	Saint Thomas Seminary	Denver
	Trinidad State Junior College	Trinidad
	University of Colorado-Boulder	Boulder
	University of Colorado-Colorado Springs	Colorado Springs
	University of Colorado-Denver	Denver
	University of Denver	Denver
	University of Denver College of Law	Denver
	University of Northern Colorado	Greeley
	University of Southern Colorado	Pueblo
	Western Bible College	Morrison
	Western State College of Colorado	Gunnison
CT	Albertus Magnus College	New Haven
	Annhurst College	Woodstock
	Bridgeport Engineering Institute	Bridgeport
	Connecticut College	New London
	Eastern Connecticut State College	Willimnatic
	Greater Hartford Community College	Hartford
	Hartford State Technical College	Hartford
	Housatonic Regional Community College	Bridgeport
	Mattuck Community College	Waterbury
	Middlesex Community College	Middletown
	Mitchell College	New London
	Mohegan Community College	Norwich
	Northwestern Connecticut Community College	Winsted
	Norwalk Community College	Norwald
	Post Junior College	Waterbury
	Quinebaug Valley Community College	Danielson
	Saint Joseph College	West Hartford

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Thames Valley State Technical College	Norwich
	Trinity College	Hartford
	Tunxis Community College	Farmington
	University of Bridgeport	Bridgeport
	University of Hartford	West Hartford
	University of New Haven	West Haven
	Yale University	New Haven
DE	Delaware State College	Dover
	Delaware Technical and Community College	Dover
	Goldey Beacom College	Wilmington
	University of Delaware	Newark
	Wesley College	Dover
DC	American University	Washington
	Catholic University of America	Washington
	District of Columbia Teachers College	Washington
	Gallaudet College	Washington
	George Washington University	Washington
	Howard University	Washington
	Mount Vernon College	Washington
	Trinity College	Washington
FL	Barry College	Miami
	Brevard Community College	Cocoa
	Broward Community College	Fort Lauderdale
	Central Florida Community College	Ocala
	Chipola Junior College	Marianna
	College of Boca Raton	Boca Raton
	Daytona Beach Community College	Daytona Beach
	Eckerd College	St. Petersburg
	Edison Community College	Fort Meyers
	Embry-Riddle Aeronautical University	Daytona Beach
	Flagler College	St. Augustine
	Florida A & M University	Tallahassee
	Florida Atlantic University	Boca Raton
	Florida College	Temple Terrace
	Florida International University	Miami
	Florida Junior College	Jacksonville
	Florida Keys Community College	Key West
	Florida Southern College	Lakeland
	Florida Technological University	Orlando
	Fort Lauderdale College	Fort Lauderdale
	Gulf Coast Community College	Panama City
	Heed University	Hollywood
	Hillsborough Community College	Tampa
	Indian River Community College	Fort Pierce
	Jacksonville University	Jacksonville
	Jones College	Jacksonville
	Lake City Community College	Lake City
	Lake-Sumter Community College	Leesburg
	Manatee Junior College	Bradenton
	Miami Christian College	Miami
	Miami-Dade Community College	Miami
	North Florida Junior College	Madison
	Nova University	Fort Lauderdale
	Okaloosa-Walton Junior College	Niceville
	Palm Beach Atlantic College	West Palm Beach
	Palm Beach Junior College	Lake Worth
	Pensacola Junior College	Pensacola
	Polk Community College	Winter Haven

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Rollins College	Winter Park
	Saint Johns River Junior College	Palatka
	Saint Leo College	Saint Leo
	Santa Fe Community College	Gainesville
	Seminole Community College	Sanford
	South-Eastern Bible College	Lakeland
	South Florida Junior College	Avon Park
	University of Florida	Gainesville
	University of Miami	Coral Gables
	University of North Florida	Jacksonville
	Warner Southern College	Lake Wales
	Webber College	Babson Park
GA	Abraham Baldwin Agricultural College	Tifton
	Agnes Scott College	Decatur
	Albany Area Vocational Technical School	Albany
	Albany Junior College	Albany
	Albany State College	Albany
	Andrew College	Cuthbert
	Armstrong State College	Savannah
	Atlanta Christian College	East Point
	Atlanta Junior College	Atlanta
	Atlanta University	Atlanta
	Augusta College	Augusta
	Bainbridge Junior College	Bainbridge
	Berry College	Mount Berry
	Brenau College	Gainesville
	Brewton-Parker College	Mount Vernon
	Carroll County Area Vocational-Technical School	Carrollton
	Carver Bible Institute and College	Atlanta
	Clark College	Atlanta
	Clayton Junior College	Morrow
	Columbus College	Columbus
	Dalton Junior College	Dalton
	DeKalb Community College	Clarkston
	Emanuel County Junior College	Swainsboro
	Emory University	Atlanta
	Fort Valley State College	Fort Valley
	Gainesville Junior College	Gainesville
	Georgia College	Milledgeville
	Georgia Institute of Technology	Atlanta
	Georgia Military College	Milledgeville
	Georgia Southern College	Statesboro
	Georgia Southwestern College	Americus
	Georgia State University	Atlanta
	Gordon Junior College	Barnesville
	Kennesaw Junior College	Marietta
	LaGrange College	LaGrange
	Macon Junior College	Macon
	Marietta-Cobb Area Vocational Technical School	Marietta
	Mercer University	Macon
	Mercer University in Atlanta	Atlanta
	Middle Georgia College	Cochran
	Morehouse College	Atlanta
	Moultrie Area Vocational-Technical School	Moultrie
	North Georgia College	Dahlonega
	North Georgia Technical and Vocational School	Clarkesville
	Oglethorpe College	Atlanta
	Pickens Area Vocational-Technical School	Jasper
	Piedmont College	Demorest
	Reinhardt College	Waleska

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Savannah Area Vocational Technical School	Savannah
	Savannah State College	Savannah
	Shorter College	Rome
	South Georgia College	Douglas
	South Georgia Technical and Vocational School	Americus
	Southern Technical Institute	Marietta
	Swainsboro Area Vocational-Technical School	Swainsboro
	Thomas Area Vocational-Technical School	Thomasville
	Tift College	Forsyth
	Toccoa Falls College	Toccoa Falls
	Troup County Area Vocational Technical School	LaGrange
	Truett McConnell College	Cleveland
	University of Georgia	Athens
	Upson County Area Vocational-Technical School	Thomaston
	Valdosta State College	Valdosta
	Valdosta Technical School	Valdosta
	Walker County Area Technical School	Rock Spring
	Waycross-Ware Area Technical School	Waycross
	Wesleyan College	Macon
	West Georgia College	Carrollton
	Young Harris College	Young Harris
HI	Brigham Young University-Hawaii Campus	Laie Oahu
	Chaminade College of Honolulu	Honolulu
	Hawaii Pacific College	Honolulu
	University of Hawaii-Honolulu Community College	Honolulu
	University of Hawaii-Kapiolani Community College	Honolulu
	University of Hawaii-Kauai Community College	Lihue
	University of Hawaii-Leeward Community College	Pearl City
	University of Hawaii-Manoa	Honolulu
	University of Hawaii-Maui Community College	Kahului
	University of Hawaii-Windward Community College	Kaneohe
ID	Boise State University	Boise
	College of Southern Idaho	Twin Falls
	Idaho State University	Pocatello
	North Idaho College	Coeur D'Alene
	Northwest Nazarene College	Nampa
	Ricks College	Rexburg
	University of Idaho	Moscow
IL	Augustana College	Rock Island
	Aurora College	Aurora
	Barat College	Lake Forest
	Belleville Area College	Belleville
	Blackburn College	Carlinville
	Black Hawk College	Moline
	Bradley University	Peoria
	Carl Sandburg College	Galesburg
	Central YMCA Community College	Chicago
	Chicago College of Osteopathic Medicine	Chicago
	Chicago State University	Chicago
	College of DuPage	Glen Ellyn

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	College of Lake County	Grayslake
	College of St. Francis	Joliet
	College of the University of Chicago	Chicago
	Danville Junior College	Danville
	DeLourdes College	Des Plaines
	DePaul University	Chicago
	DeVry Institute of Technology	Chicago
	Eastern Illinois University	Charleston
	Elgin Community College	Elgin
	Elmhurst College	Elmhurst
	Eureka College	Eureka
	George Williams College	Downers Grove
	Governors State University	Park Forest South
	Greenville College	Greenville
	Highland Community College	Freeport
	Illinois Benedictine College	Lisle
	Illinois Central College	East Peoria
	Illinois College	Jacksonville
	Illinois College of Optometry	Chicago
	Illinois College of Podiatric Medicine	Chicago
	Illinois Institute of Technology	Chicago
	Illinois State University	Normal
	Illinois Valley Community College	Oglesby
	Illinois Wesleyan University	Bloomington
	Joliet Junior College	Joliet
	Judson College	Elgin
	Kankakee Community College	Kankakee
	Kendall College	Evanston
	Kishwaukee College	Malta
	Knox College	Galesburg
	Lake Forest College	Evanston
	Lakeland College	Mattoon
	Lewis and Clark Community College	Godfrey
	Lincoln Trail College	Robinson
	Logan (John A.) College	Carterville
	Loyola University of Chicago	Chicago
	MacMurray College	Jacksonville
	McHenry County College	Crystal Lake
	McKendree College	Lebanon
	Meadville Theological School	Lombard
	Millikin University	Decatur
	Moraine Valley Community College	Palos Hills
	National College of Chiropractic	Lombard
	North Central College	Naperville
	Northeastern Illinois University	Chicago
	Northern Baptist Theological Seminary	Lombard
	Northern Illinois University	DeKalb
	Northwestern University	Evanston
	Oakton Community College	Morton Grove
	Olivet Nazarene College	Kankakee
	Olney Central College	Mt. Carmel
	Prairie State Community College	Chicago Heights
	Rockford College	Rockford
	Rock Valley College	Rockford
	Roosevelt University	Chicago
	Rush University, College of Nursing and Allied Health Sciences	Chicago
	Rush University, Rush Medical College	Chicago
	Sangamon State University	Springfield
	Sauk Valley College	Dixon
	Southern Illinois University	Carbondale
	Southern Illinois University	Edwardsville
	Spertus College of Judaica	Chicago
	Spoon River College	Canton
	Springfield College in Illinois	Springfield

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	State Community College of East Saint Louis, Illinois	East St. Louis
	Thornton Community College	South Holland
	Triton College	River Grove
	University of Health Sciences, The Chicago Medical School	Chicago
	University of Illinois at Chicago Circle	Chicago
	University of Illinois at the Medical Center, School of Public Health	Chicago
	University of Illinois at Urbana-Champaign	Urbana-Champaign
	Wabash Valley College	Mt. Carmel
	Waubonsee Community College	Sugar Grove
	Western Illinois University	Macomb
	Wheaton College	Wheaton
	William Rainey Harper College	Palatine
IN	Anderson College	Anderson
	Associated Mennonite Biblical Seminary	Elkhart
	Ball State University	Muncie
	Bethel College	Mishawaka
	Butler University	Indianapolis
	DePauw University	Greencastle
	Earlham College	Richmond
	Franklin College	Franklin
	Goshen College	Goshen
	Grace College	Winona Lake
	Hanover College	Hanover
	Holy Cross Junior College	Notre Dame
	Huntington College	Huntington
	Indiana Central College	Indianapolis
	Indiana Institute of Technology	Fort Wayne
	Indiana State University	Evansville
	Indiana University	Bloomington
	Indiana University-East	Richmond
	Indiana University-Kokomo	Kokomo
	Indiana University-Northwest	Gary
	Indiana University-South Bend	South Bend
	Indiana University-Southeast	New Albany
	Indiana University-Purdue University at Fort Wayne	Fort Wayne
	Indiana Vocational Technical College	Indianapolis
	International Junior College	Fort Wayne
	Manchester College	North Manchester
	Marian College	Indianapolis
	Marion College	Marion
	Oakland College	Oakland City
	Purdue State University	Muncie
	Purdue University	West Lafayette
	Purdue University-Calumet	Calumet
	Purdue University-North Central	Westville
	Rose-Hulman Institute of Technology	Terre Haute
	Saint Joseph's College	Rensselaer
	Saint Mary's College	Notre Dame
	Saint Mary of the Woods College	Saint Mary of the Woods
	Saint Meinard College	St. Meinard
	Taylor University	Upland
	Tri-State University	Angola
	University of Evansville	Evansville
	University of Notre Dame	South Bend
	Valparaiso University	Valparaiso
	Vincennes University	Vincennes
	Wabash College	Crawfordsville

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
IA	Area One Vocational-Technical School	Calmar and Dubuque
	Briar Cliff College	Sioux City
	Central College	Pella
	Clarke College	Dubuque
	Coe College	Cedar Rapids
	Cornell College	Mt. Vernon
	Des Moines Area Community College	Ankeny
	Drake University	Des Moines
	Ellsworth Community College	Iowa Falls
	Grinnell College	Grinnell
	Hawkeye Institute of Technology	Waterloo
	Iowa Central Community College	Fort Dodge
	Iowa Lakes Community College	Estherville
	Iowa State University	Ames
	Iowa Wesleyan College	Mount Pleasant
	Iowa Western Community College	Council Bluffs
	Kirkwood Community College	Cedar Rapids
	Loras College	Dubuque
	Luther College	Decorah
	Marshalltown Community College	Marshalltown
	Marycrest College	Davenport
	Morningside College	Sioux City
	Mount Mercy College	Cedar Rapids
	North Iowa Area Community College	Mason City
	Open Bible College	Des Moines
	Palmer College of Chiropractic	Davenport
	Simpson College	Indianola
	Southeastern Community College	Burlington
	Southwestern Community College	Creston
	University of Dubuque	Dubuque
	University of Dubuque Theological Seminary	Dubuque
	University of Iowa	Iowa City
	University of Northern Iowa	Cedar Falls
	Upper Iowa University	Fayette
	Wartburg College	Waverly
	Wartburg Seminary	Dubuque
	Westmar College	LeMars
	Western Iowa Technical Community College	Sioux City
KS	Allen County Community Junior College	Iola
	Baker University	Baldwin
	Barton County Community College	Great Bend
	Benedictine College	Atchison
	Bethel College	North Newton
	Central College	McPherson
	Cloud County Community College	Concordia
	Coffeyville Community Junior College	Coffeyville
	Colby Community College	Colby
	Cowley County Community College	Arkansas City
	Dodge City Community College	Dodge City
	Donnelly College	Kansas City
	Emporia Kansas State College	Emporia
	Fort Hays Kansas State College	Hays
	Fort Scott Community College	Fort Scott
	Friends Bible College	Haviland
	Garden City Community College	Garden City
	Haskell Indian Junior College	Lawrence
	Hesston College	Hesston
	Highland Community Junior College	Highland
	Hutchinson Community Junior College	Hutchinson
	Independence Community Junior College	Independence
	Johnson County Community College	Overland Park
	Kansas City Community College	Kansas City

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Kansas Newman College	Wichita
	Kansas State College of Pittsburg	Pittsburg
	Kansas State University	Manhattan
	Kansas Technical Institute	Salina
	Kansas Wesleyan	Salina
	Labette Community Junior College	Parsons
	Manhattan Christian College	Manhattan
	Marymount College of Kansas	Salina
	McPherson College	McPherson
	Mid-America Nazarene College	Olathe
	Neosho County Community Junior College	Chanute
	Ottawa University	Ottawa
	Pratt Community College	Pratt
	Saint John's College	Winfield
	Saint Mary College	Leavenworth
	Saint Mary of the Plains College	Dodge City
	Seward County Community College	Liberal
	Southwestern College in Kansas	Winfield
	Sterling College	Sterling
	Tabor College	Hillsboro
	The University of Kansas	Lawrence
	Washburn University of Topeka	Topeka
	Wichita State University	Wichita
KY	Alice Lloyd College	Pippa Passes
	Asbury College	Wilmore
	Bellarmine College	Louisville
	Berea College	Berea
	Brescia College	Owensboro
	Campbellsville College	Campbellsville
	Centre College of Kentucky	Danville
	Cumberland College	Williamsburg
	Eastern Kentucky University	Richmond
	Georgetown College	Georgetown
	Jefferson Vocational Regional Office	Jeffersontown
	Kentucky Christian College	Grayson
	Kentucky State University	Frankfort
	Kentucky Wesleyan College	Owensboro
	Lees Junior College	Jackson
	Lindsey Wilson College	Columbia
	Midway College	Midway
	Morehead State University	Morehead
	Murray State University	Murray
	Pikeville College	Pikeville
	Saint Catharine College	Saint Catharine
	Southeastern Christian College	Winchester
	Sue Bennett College	London
	Thomas More College	Fort Mitchell
	Transylvania University	Lexington
	University of Kentucky	Lexington
	University of Kentucky Community College System	Lexington
	University of Louisville	Louisville
	Western Kentucky University	Bowling Green
LA	Bossier Parish Community College	Bossier City
	Centenary College of Louisiana	Shreveport
	Delgado College	New Orleans
	Dillard University	New Orleans
	Grambling State University	Grambling
	Louisiana State University-Central Office	Baton Rouge

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Louisiana State University and Agricultural and Mechanical College at Baton Rouge	Baton Rouge
	Louisiana State University-Alexandria	Alexandria
	Louisiana State University-Eunice	Eunice
	Louisiana State University-Shreveport	Shreveport
	University of New Orleans	New Orleans
	Louisiana Tech University	Ruston
	McNeese State University	Lake Charles
	New Orleans Baptist Theological Seminary	New Orleans
	Northeast Louisiana University	Monroe
	Northwestern State University of Louisiana	Natchitoches
	Notre Dame Seminary School of Theology	New Orleans
	Our Lady of Holy Cross College	New Orleans
	Saint Bernard Parish Community College	Chalmette
	Saint Joseph Seminary College	Saint Benedict
	Saint Mary's Dominican College	New Orleans
	Southern University in New Orleans	New Orleans
	Tulane University of Louisiana	New Orleans
	Xavier University of Louisiana	New Orleans
ME	Bowdoin College	Brunswick
	Colby College	Waterville
	College of the Atlantic	Bar Harbor
	Eastern Maine Vocational and Technical Institute	Bangor
	Maine Maritime Academy	Castine
	Masson College	Springvale
	South Maine Vocational and Technical Institute	South Portland
	Unity College	Unity
	University of Maine at Orono	Orono
MD	Bowie State College	Bowie
	Catonsville Community College	Catonsville
	Charles County Community College	La Plata
	Chesapeake College	Wye Mills
	Columbia Union College	Takoma Park
	Community College of Baltimore	Baltimore
	Dundalk Community College	Baltimore
	Essex Community College	Baltimore County
	Garrett Community College	McHenry
	Goucher College	Towson
	Hagerstown Junior College	Hagerstown
	Harford Community College	Bel Air
	Hood College	Frederick
	Howard Community College	Columbia
	Johns Hopkins University	Baltimore
	Loyola College	Baltimore
	Montgomery College	Rockville
	Saint John's College	Annapolis
	Saint Mary's College of Maryland	Saint Mary's City
	Towson State College	Baltimore
	University of Baltimore	Baltimore
	University of Maryland	College Park
	Villa Julie College	Stevenson
	Washington College	Chestertown

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
MA	Amherst College	Amherst
	Anna Maria College	Paxton
	Assumption College	Worcester
	Bay Path Junior College	Longmeadow
	Bentley College	Waltham
	Boston College	Chestnut Hill
	Boston University	Boston
	Gordon College	Wenham
	Hampshire College	Amherst
	Harvard University	Cambridge
	Lasell Junior College	Auburndale
	Lesley College	Cambridge
	Massachusetts Institute of Technology	Cambridge
	Merrimack College	North Andover
	Mount Holyoke College	South Hadley
	Nichols College	Dudley
	Northeastern University	Boston
	Regis College	Weston
	Simon's Rock	Great Barrington
	Smith College	Northampton
	Southeastern Massachusetts University	North Darmouth
	Springfield College	Springfield
	Springfield Technical Community College	Springfield
	Stonehill College	North Easton
	Suffolk University	Boston
	Tufts University	Medford
	University of Massachusetts	Boston
	Wentworth Institute	Boston
	Wheelock College	Boston
	Williams College	Williamstown
	Worcester Junior College	Worcester
	Worcester Polytechnic Institute	Worcester
MI	Alma College	Alma
	Alpena Community College	Alpena
	Andrews University	Berrien Springs
	Aquinas College	Grand Rapids
	Bay de Noc Community College	Escanaba
	Calvin College	Grand Rapids
	Calvin Theological Seminary	Grand Rapids
	Central Michigan University	Mount Pleasant
	Concordia Lutheran Junior College	Ann Arbor
	Delta College	University Center
	Detroit Institute of Technology	Detroit
	Eastern Michigan University	Ypsilanti
	Ferris State College	Big Rapids
	General Motors Institute	Flint
	Grace Bible College	Wyoming
	Grand Rapids Baptist College	Grand Rapids
	Grand Rapids Junior College	Grand Rapids
	Grand Valley State College	Allendale
	Highland Park Community College	Highland Park
	Hillsdale College	Hillsdale
	Hope College	Holland

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Jackson Community College	Jackson
	Kalamazoo College	Kalamazoo
	Kalamazoo Valley Community College	Kalamazoo
	Kirtland Community College	Roscommon
	Lake Michigan College	Benton Harbor
	Lake Superior State College	Saulte Ste. Marie
	Lansing Community College	Lansing
	Macomb County Community College	Warren
	Madonna College	Livonia
	Marygrove College	Detroit
	Mercy College of Detroit	Detroit
	Merrill-Palmer Institute	Detroit
	Michigan Department of Education-Environmental Guidelines	Lansing
	Michigan State University	East Lansing
	Michigan Technological University	Houghton
	Mid Michigan Community College	Harrison
	Monroe County Community College	Monroe
	Montcalm Community College	Sidney
	Mott Community College	Flint
	Muskegon Business College	Muskegon
	Muskegon Community College	Muskegon
	Northern Michigan University	Marquette
	Northwestern Michigan College	Traverse City
	Oakland Community College	Bloomfield Hills
	Oakland University	Rochester
	Olivet College	Olivet
	Saginaw Valley State College	University Center
	Saint Mary's College	Orchard Lake
	Schoolcraft College	Livonia
	Shaw College at Detroit	Detroit
	Southwestern Michigan College	Dowagiac
	Spring Arbor College	Spring Arbor
	Suomi College	Hancock
	University of Detroit	Detroit
	University of Michigan	Ann Arbor
	Walsh College	Troy
	Washtenaw Community College	Ann Arbor
	Wayne County Community College	Detroit
	Wayne State University	Detroit
	Western Michigan University	Kalamazoo
	West Shore Community College	Scottville
	Western Theological Seminary	Holland
MN	Anoka-Ramsey Community College	Coon Rapids
	Augsburg College	Minneapolis
	Austin Community College	Austin
	Bemidji State University	Bemidji
	Bethany Lutheran College	Mankato
	Brainerd Community College	Brainerd
	Carleton College	Northfield
	College of Saint Benedict	St. Joseph
	College of St. Catherine	St. Paul
	College of St. Scholastica	Duluth
	College of St. Thomas	St. Paul
	Concordia College	Moorhead
	Crosier Seminary Junior College	Onamia
	Dr. Martin Luther College	New Ulm
	Fergus Falls Community College	Fergus Falls
	Hibbing Community College	Hibbing
	Itasca Community College	Grand Rapids
	Lakewood Community College	White Bear Lake
	Luther Theological Seminary	St. Paul
	Macalester College	St. Paul
	Mankato State University	Mankato

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Mesabi Community College	Virginia
	Metropolitan Community College	Minneapolis
	Metropolitan State University	St. Paul
	Minneapolis College of Art and Design	Minneapolis
	Minnesota Bible College	Rochester
	Moorhead State College	Moorhead
	Normandale Community College	Bloomington
	North Hennepin Community College	Minneapolis
	Northland Community College	Thief River Falls
	Northwestern College	Roseville
	Rainy River Community College	International Falls
	Rochester Community College	Rochester
	Saint John's University	Collegeville
	Saint Mary's College	Winona
	Southwest Minnesota State College	Marshall
	St. Cloud Area Vocational Technical Institute	St. Cloud
	St. Cloud State University	St. Cloud
	St. Mary's Junior College	Minneapolis
	St. Paul Bible College	Bible College
	United Theological Seminary of the Twin Cities	New Brighton
	University of Minnesota	Minneapolis
	Vermilion Community College	Ely
	William Mitchell College of Law	St. Paul
	Winona State University	Winona
	Worthington Community College	Worthington
MS	Alcorn State University	Lorman
	Belhaven College	Jackson
	Clarke College	Newton
	Coahama Junior College	Clarksdale
	Copiah-Lincoln Junior College	Wesson
	Delta State University	Cleveland
	East Central Junior College	Decatur
	East Mississippi Junior College	Scooba
	Hinds Junior College	Raymond
	Holmes Junior College	Goodman
	Itawamba Junior College	Fulton
	Jackson State University	Jackson
	John C. Stennis Vocational Complex	Dekalb
	Jones County Junior College	Ellisville
	Mary Holmes College	West Point
	Meridian Junior College	Meridian
	Millsaps College	Jackson
	Mississippi College	Clinton
	Mississippi Delta Junior College	Moorhead
	Mississippi Gulf Coast Junior College	Perkinston
	Mississippi Industrial College	Holly Springs
	Mississippi State University	Mississippi State
	Mississippi University for Women	Columbus
	Northeast Mississippi Junior College	Booneville
	Northwest Mississippi Junior College	Senatobia
	Pearl River Junior College	Poplarville
	Rust College	Holly Springs
	Southwest Mississippi Junior College	Summit
	Tougaloo College	Tougaloo
	University of Mississippi	University
	University of Mississippi Medical Center	Jackson
	University of Southern Mississippi	Hattiesburg
	Utica Junior College	Utica
	Wesley College	Florence
	William Carey College	Hattiesburg
	Wood Junior College	Mathiston

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
MO	Assemblies of God Graduate School	Springfield
	Avila College	Kansas City
	Calvary Bible College	Kansas City
	Central Bible College	Springfield
	Central Methodist College	Fayette
	Central Missouri State University	Warrensburg
	Columbia College	Columbia
	Concordia Seminary	St. Louis
	Cottey College	Nevada
	Crowder College	Neosho
	Culver-Stockton College	Canton
	Fontbonne College	St. Louis
	Hannibal Lagrange College	Hannibal
	Harris Teachers College	St. Louis
	Jefferson College	Hillsboro
	Kansas City Art Institute	Kansas City
	Kansas City College of Osteopathic Medicine	Kansas City
	Logan College of Chiropractic	Chesterfield
	Longview Community College	Kansas City
	Maple Woods Community College	Kansas City
	Maryville College	St. Louis
	Meramec Community College	St. Louis
	Missouri Baptist College	St. Louis
	Missouri Southern State College	Joplin
	Moberly Area Junior College	Moberly
	Northeast Missouri State University	Kirksville
	Northwest Missouri State University	Maryville
	Rockhurst College	Kansas City
	Saint Louis College of Pharmacy	St. Louis
	Saint Louis Community College at Forest Park	St. Louis
	Saint Louis University	St. Louis
	Saint Paul's College	Concordia
	School of the Ozarks	Point Lookout
	Southwest Missouri State University	Springfield
	State Fair Community College	Sedalia
	Stephen's College	Columbia
	Tarkio College	Tarkio
	The Principia	St. Louis
	Three Rivers Community College	Poplar Bluff
	University of Missouri-Columbia	Columbia
	University of Missouri-Kansas City	Kansas City
	University of Missouri-Rolla	Rolla
	University of Missouri-St. Louis	St. Louis
	Washington University	St. Louis
	Water and Wastewater Technical School	Neosho
	Webster College	Webster
	Westminster College	Fulton
	William Jewell College	Kansas City
MT	Carroll College	Helena
	College of Great Falls	Great Falls
	Dawson College	Glendive
	Eastern Montana College	Billings
	Flathead Valley Community College	Kalispell
	Miles Community College	Miles City
	Montana College of Mineral Science and Technology	Butte
	Montana State University	Bozeman
	Northern Montana College	Havre
	Rocky Mountain College	Billings
	University of Montana	Missoula
	Western Montana College	Dillon

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
NE	Central Technical Community College	Hastings
	Chadron State College	Chadron
	College of Saint Mary	Omaha
	Concordia College	Seward
	Creighton University	Omaha
	Dana College	Blair
	Doane College	Crete
	Grace College of the Bible	Omaha
	Hastings College	Hastings
	Kearney State College	Kearney
	McCook Community College	McCook
	Midland Lutheran College	Fremont
	Mid-Plains Community College	North Platte
	Northeast Technical Community College	Norfolk
	Platte Technical Community College	Columbus
	Southeast Community College	Lincoln
	Union College	Lincoln
	University of Mid-America	Lincoln
	University of Nebraska	Lincoln
	Wayne State College	Wayne
NV	University of Nevada-Las Vegas	Las Vegas
	University of Nevada-Reno	Reno
	Clark County Community College	Las Vegas
	Northern Nevada Community College	Elko
	Sierra Nevada College	Incline Village
	Western Nevada Community College	Carson City
NH	Colby-Sawyer College	New London
	Dartmouth College	Hanover
	Franklin Pierce College	Rindge
	New England College	Henniker
	NH Technical Institute	Concord
	NH Voc-Tech College of Berlin	Berlin
	NH Voc-Tech College of Claremont	Claremont
	NH Voc-Tech College of Laconia	Laconia
	NH Voc-Tech College of Manchester	Manchester
	NH Voc-Tech College of Nashua	Nashua
	NH Voc-Tech College of Portsmouth	Portsmouth
	Saint Anselm's College	Manchester
	University of New Hampshire	Durham
	White Pines College	Chester
NJ	Atlantic Community College	Mays Landing
	Bergen Community College	Paramus
	Brookdale Community College	Lincroft
	Burlington County College	Penberton
	Camden County College	Caldwell
	Centenary College for Women	Hackettstown
	County College of Morris	Dover
	Cumberland County College	Vineland
	Drew University	Madison
	Fairleigh Dickinson University	Rutherford
	Gloucester County College	Sewell
	Kean College of New Jersey	Union
	Mercer County Community College	Trenton
	Middlesex County College	Edison
	Montclair State College	Upper Montclair
	New Jersey Institute of Technology	Newark
	Ocean County College	Toms River
	Passaic County Community College	Paterson
	Princeton University	Princeton

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Rider College	Trenton
	Rutgers the State University	New Brunswick
	Stevens Institute of Technology	Hoboken
	Trenton State College	Trenton
	Union College	Cranford
	Union County Technical Institute	Scotch Plains
	William Paterson College	Wayne
NM	College of the Southwest	Hobbs
	Eastern New Mexico University-Main Campus	Portales
	Eastern New Mexico University-Roswell	Roswell
	New Mexico Highlands University	Las Vegas
	New Mexico Institute of Mining and Technology	Socorro
	New Mexico Junior College	Hobbs
	New Mexico Military Institute	Roswell
	New Mexico State University-Las Cruces	Las Cruces
	New Mexico State University-San Juan	San Juan
	University of Albuquerque	Albuquerque
	University of New Mexico-Main Campus	Albuquerque
NY	Adelphi University	Garden City
	Albany College Pharmacy	Albany
	Albany Law School	Albany
	Alfred University	Alfred
	Bard College	Annandale-on-Hudson
	Bronx Community College	Bronx
	Brooklyn Law School	Brooklyn
	Canisius	Buffalo
	City University of New York	New York
	Clarkson College of Technology	Potsdam
	Colgate University	Hamilton
	College of Mt. Saint Vincent	Riverdale
	College of Saint Rose	Albany
	Columbia University	New York
	Concordia College	Bronxfille
	Cornell University	Ithaca
	Dowling College	Oakdale Long Island
	D'Youville College	Buffalo
	Erie Community College	Buffalo
	Hamilton College	Clinton
	Hartwick College	Oneonta
	Hilbert College	Hamburg
	Hobart-William Smith Colleges	Geneva
	Hofstra University	Hempstead
	Houghton College	Houghton
	Hudson Valley Community College	Troy
	Hunter College	New York
	Ithaca College	Ithaca
	King's College	Briarcliff Manor
	Long Island University	Greenvale
	Manhattan College	Bronx
	Medaille College	Buffalo
	Mercy College	Dobbs Ferry
	Molloy College	Rockville Centre
	New School for Social Research	New York
	New York Institute of Technology	Old Westbury
	New York Law School	New York
	Niagara University	Niagara University

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Paul Smith's College of Arts & Science	Paul Smiths
	Polytechnic Institute of New York	Brooklyn
	Rensselaer Polytechnic Institute	Troy
	Roberts Wesleyan College	Rochester
	Rochester Institute of Technology	Rochester
	Rockefeller University	New York
	Saint Banaventure University	Saint Bonaventure
	Saint John Fisher College	Rochester
	Saint John's University	Jamaica
	Saint Lawrence University	Canton
	Saint Thomas Aquinas College	Sparkhill
	Skidmore College	Saratoga Springs
	Southampton College	Southampton
	State University of New York at Buffalo	Buffalo
	Syracuse University	Syracuse
	The Cooper Union	New York
	Trocaire College	Buffalo
	Ulster County Community College	Stone Ridge
	University of Rochester	Rochester
	Vassar College	Poughkeepsie
	Wagner College	Staten Island
	Webb Institute of Naval Architecture	Glen Cove
	Westchester Community College	Valhalla
NC	Anson Technical Institute	Ansonville
	Appalachian State University	Boone
	Asheville Buncombe Technical Institute	Asheville
	Atlantic Christian College	Wilson
	Beaufort County Technical Institute	Washington
	Belmont Abbey College	Belmont
	Bennett College	Greensboro
	Bladen Technical Institute	Dublin
	Blue Ridge Technical Institute	Flat Rock
	Brevard College	Brevard
	Campbell College	Buies Creek
	Cape Fear Technical Institute	Wilmington
	Carteret Technical Institute	Morehead City
	Catawba College	Salisbury
	Catawba Valley Technical Institute	Hickory
	Central Carolina Technical Institute	Sanford
	Central Piedmont Community College	Charlotte
	Chowan College	Murfreesboro
	Cleveland County Technical Institute	Shelby
	Coastal Carolina Community College	Jacksonville
	College of the Albemarle	Elizabeth City
	Craven Community College	New Bern
	Davidson College	Davidson
	Davidson County Community College	Lexington
	Duke University	Durham
	Durham College	Durham
	East Carolina University	Greenville
	Elon College	Elon College
	Fayetteville State University	Fayetteville
	Fayetteville Technical Institute	Fayetteville
	Gardner Webb College	Boiling Springs
	Gaston College	Dallas
	Greensboro College	Greensboro
	Guilford College	Greensboro
	Guilford Technical Institute	Jamestown
	Halifax Community College	Weldon
	Haywood Technical Institute	Clyde
	High Point College	High Point
	Isothermal Community College	Spindale
	James Sprunt Institute	Kenansville
	Johnson C. Smith University	Charlotte

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Johnston Technical Institute	Smithfield
	Lees-McCrae College	Banner Elk
	Lenoir Community College	Kinston
	Lenoir-Rhyne College	Hickory
	Livingstone College	Salisbury
	Louisburg College	Louisburg
	Mars Hill College	Mars Hill
	Martin Community College	Williamston
	Mayland Technical Institute	Spruce Pine
	McDowell Technical Institute	Marion
	Meredith College	Raleigh
	Methodist College	Fayetteville
	Montreat-Anderson College	Montreat
	Mount Olive College	Mount Olive
	Nash Technical Institute	Rocky Mount
	North Carolina Agricultural and Technical State University	Greensboro
	North Carolina Central University	Durham
	North Carolina State University	Raleigh
	North Carolina Wesleyan College	Rocky Mount
	Pembroke State University	Pembroke
	Pfeiffer College	Misenheimer
	Piedmont Bible College	Winston-Salem
	Piedmont Technical Institute	Roxboro
	Pitt Technical Institute	Greenville
	Queens College	Charlotte
	Randolph Technical Institute	Asheboro
	Richmond Technical Institute	Hamlet
	Roanoke-Chowan Technical Institute	Ahoskie
	Robeson Technical Institute	Lumberton
	Rockingham Community College	Wentworth
	Rowan Technical Institute	Salisbury
	Saint Andrews Presbyterian College	Laurinburg
	Saint Augustine's College	Raleigh
	Saint Mary's College	Raleigh
	Salem College	Winston-Salem
	Sampson Technical Institute	Clinton
	Sandhills Community College	Carthage
	Shaw University	Raleigh
	Stanly Technical Institute	Albermarle
	Surry Community College	Dobson
	Technical Institute of Alamance	Burlington
	Tri-County Technical Institute	Murphy
	University of North Carolina at Chapel Hill	Chapel Hill
	University of North Carolina at Charlotte	Charlotte
	University of North Carolina at Greensboro	Greensboro
	University of North Carolina at Wilmington	Wilmington
	Wake Forest University	Winston-Salem
	Wake Technical Institute	Raleigh
	Warren Wilson College	Swannanoa
	Wayne Community College	Goldsboro
	Western Carolina University	Cullowhee
	Western Piedmont Community College	Morganton
	Wilkes Community College	Wilkesboro
	Wilson County Technical Institute	Wilson
	Wingate College	Wingate
	Winston-Salem State University	Winston-Salem

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
ND	Bismarck Junior College	Bismarck
	Dickinson State College	Dickinson
	Jamestown College	Jamestown
	Lake Region Junior College	Devils Lake
	Mary College	Bismarck
	Mayville State College	Mayville
	Minot State College	Minot
	North Dakota State School of Science	Wahpeton
	North Dakota State University-Main Campus	Fargo
	North Dakota State University-Bottineau	Bottineau
	Trinity Bible Institute	Ellendale
	University of North Dakota-Main Campus	Grand Forks
	University of North Dakota-Williston	Williston
OH	Antioch College	Yellow Springs
	Art Academy of Cincinnati	Cincinnati
	Bluffton College	Bluffton
	Capital University	Columbus
	Case Western Reserve University	Cleveland
	Central Ohio Technical College	Newark
	Central State University	Wilberforce
	Cincinnati Bible College	Cincinnati
	Cincinnati Technical College	Cincinnati
	Clark Technical College	Springfield
	Cleveland Institute of Art	Cleveland
	Cleveland Institute of Music	Cleveland
	Cleveland State University	Cleveland
	College of Mount St. Joseph on the Ohio	Cincinnati
	College of Steubenville	Steubenville
	College of Wooster	Wooster
	Columbus College of Art and Design	Columbus
	Columbus Technical Institute	Columbus
	Cuyahoga Community College	Cleveland
	Davis Junior College	Toledo
	Defiance College	Defiance
	Denison University	Granville
	Franklin University	Columbus
	Hebrew Union College	Cincinnati
	Heidelberg College	Tiffin
	Hiram College	Hiram
	Hocking Technical College	Nelsonville
	Jefferson County Technical Institute	Steubenville
	John Carroll University	Cleveland
	Josephinum College of Liberal Arts	Worthington
	Kent State University	Kent
	Kenyon College	Gambier
	Kettering College of Medical Arts	Kettering
	Lakeland Community College	Mentor
	Lima Technical College	Lima
	Lorain County Community College	Elyria
	Lutheran Theological Seminary	Columbus
	Malone College	Canton
	Marietta College	Marietta
	Marion Technical College	Marion
	Medical College of Ohio	Toledo
	Miami-Jacobs Junior College	Dayton
	Miami University	Oxford
	Mount Union College	Alliance
	Mount Vernon Nazarene College	Mount Vernon
	Muskingum Area Technical College	Zanesville
	Muskingum College	New Concord
	National Training and Operational Technology Center (EPA)	Cincinnati
	North Central Technical College	Mansfield

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Northwest Technical College	Archbold
	Notre Dame College	Cleveland
	Oberlin College	Oberlin
	Ohio Board of Regents-Technical Education Offerings	Columbus
	Ohio Dominican College	Columbus
	Ohio Northern University	Ada
	Ohio State University	Columbus
	Ohio University	Athens
	Ohio Wesleyan University	Delaware
	Owens Technical College	Perrysburg
	Saint John College of Cleveland	Cleveland
	Sinclair Community College	Dayton
	Stark Technical College	Canton
	Tiffin University	Tiffin
	United Theological Seminary	Dayton
	University of Cincinnati	Cincinnati
	University of Dayton	Dayton
	University of Toledo	Toledo
	Urbana College	Urbana
	Washington Technical College	Marietta
	Wittenberg University	Springfield
	Wright State University	Dayton
	Xavier University	Cincinnati
	Youngstown State University	Youngstown
OK	Bacone College	Muskogee
	Bartlesville Weslyan College	Bartlesville
	Bethany Nazarene College	Bethany
	Cameron University	Lawton
	Carl Albert Junior College	Poteau
	Central State University	Edmond
	Claremore Junior College	Claremore
	Connors State College	Warner
	East Central Oklahoma State University	Ada
	Eastern Oklahoma State College	Wilburton
	El Reno Junior College	El Reno
	Hillsdale Free Will Baptist College	Moore
	Midwest Christian College	Oklahoma City
	Murray State College	Tishomingo
	Northeastern Oklahoma Agricultural and Mechanical College	Miami
	Northeastern Oklahoma State University	Tahlequah
	Northern Oklahoma College	Tonkawa
	Northwestern Oklahoma State University	Alva
	Oklahoma Baptist University	Shawnee
	Oklahoma Christian College	Oklahoma City
	Oklahoma City University	Oklahoma City
	Oklahoma Panhandle State University	Goodwell
	Oklahoma School of Business, Accountancy, Law and Finance	Tulsa
	Oklahoma State University-Main Campus	Stillwater
	Oklahoma State University-Oklahoma City	Oklahoma City
	Oral Roberts University	Tulsa
	Oscar Rose Junior College	Midwest City
	Phillips University	Enid
	Saint Gregory's College	Shawnee
	Sayre Junior College	Sayre
	Seminole Junior College	Seminole
	Southeastern Oklahoma State University	Durant
	South Oklahoma City Junior College	Oklahoma City
	Southwestern College	Oklahoma City
	Tulsa Junior College	Tulsa
	University of Oklahoma-Central Office	Norman

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	University of Oklahoma-Health Science Center	Oklahoma City
	University of Science and Arts of Oklahoma	Chickasha
	University of Tulsa	Tulsa
	Western Oklahoma State College	Altus
OR	Blue Mountain Community College	Pendleton
	Chemeketa Community College	Salem
	Clackamas Community College	Oregon City
	Clatsop Community College	Astoria
	Columbia Christian College	Portland
	Concordia College	Portland
	George Fox College	Newberg
	Judson Baptist College	Portland
	Lane Community College	Eugene
	Lewis and Clark College	Portland
	Linfield College	McMinnville
	Linn-Benton Community College	Albany
	Marylhurst Education Center	Marylhurst
	Mount Hood Community College	Gresham
	Multnomah School of the Bible	Portland
	Museum Art School	Portland
	Oregon State Higher Education District	
	Eastern Oregon State College	La Grande
	Oregon College of Education	Monmouth
	Oregon Institute of Technology	Klamath Falls
	Oregon State University	Corvallis
	Portland State University	Portland
	Southern Oregon State College	Ashland
	University of Oregon-Health Sciences Center	Portland
	Pacific University	Forest Grove
	Reed College	Portland
	Southwestern Oregon Community College	Coos Bay
	Treasure Valley Community College	Ontario
	Umpqua Community College	Rosenburg
	University of Portland	Portland
	Warner Pacific College	Portland
	Western Baptist Bible College	Salem
	Western Conservative Baptist Seminary	Portland
	Western Evangelical Seminary	Portland
	Williamette University	Salem
PA	Allegheny College	Meadville
	Allentown College of St. Francis De Sales	Center Valley
	Alliance College	Cambridge Springs
	Beaver College	Glenside
	Bloomsburg State College	Bloomsburg
	Bucks County Community College	Newton
	Butler County Community College	Butler
	Cabrini College	Radnor
	California State College	California
	Carlow College	Pittsburgh
	Carnegie-Mellon University	Pittsburgh
	Cedar Crest College	Allentown
	Chestnut Hill College	Philadelphia
	Cheyney State College	Cheyney
	Clarion State College	Clarion
	Community College of Allegheny County	Pittsburgh
	Community College of Beaver County	Monaca
	Community College of Philadelphia	Philadelphia
	Delaware Valley College of Science and Agriculture	Doylestown

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Dickinson College	Carlisle
	Drexel University	Philadelphia
	The Dropsie University	Philadelphia
	Duquesne University	Pittsburgh
	Eastern College	Saint Davids
	East Stroudsburg State College	East Stroudsburg
	Edinboro State College	Edinboro
	Franklin-Marshall College	Lancaster
	Gannon College	Erie
	Geneva College	Beaver Falls
	Gettysburg College	Gettysburg
	Gwynedd-Mercy College	Gwynedd Valley
	Harcum Junior College	Bryn Mawr
	Haverford College	Haverford
	Indiana University of Pennsylvania	Indiana
	Juniata College	Huntingdon
	Keystone Junior College	La Plume
	King's College	Wilkes-Barre
	Lafayette College	Easton
	La Roche College	Allison Park
	La Salle College	Philadelphia
	Lehigh University	Bethlehem
	Lincoln University	Lincoln University
	Lock Haven State College	Lock Haven
	Lycoming College	Williamsport
	Mansfield State College	Mansfield
	Marywood College	Scranton
	Mercyhurst College	Erie
	Millersville State College	Millersville
	Montgomery County Community College	Blue Bell
	Northeastern Christian Junior College	Villanova
	Pennsylvania State University	University Park
	Philadelphia College of Pharmacy and Science	Philadelphia
	Point Park College	Pittsburgh
	Reading Area Community College	Reading
	Saint Fidelis College	Herman
	Saint Francis College	Loretto
	Saint Joseph's College	Philadelphia
	Saint Vincent College	Latrobe
	Seton Hill College	Greensburg
	Slippery Rock State College	Slippery Rock
	Spring Garden College	Chestnut Hill
	Susquehanna University	Selinsgrove
	Swarthmore College	Swarthmore
	Temple University	Philadelphia
	University of Pennsylvania	Philadelphia
	University of Pittsburg	Pittsburgh
	University of Scranton	Scranton
	Ursinus College	Collegeville
	Villa Maria College	Erie
	Villanova University	Villanova
	Waynesburg College	Waynesburg
	West Chester State College	West Chester
	Westminster College	New Wilmington
	Widener College	Chester
	Wilkes College	Wilkes-Barre
	Williamsport Area Community College	Williamsport
	Wilson College	Chambersburg
PR	Inter American University of Puerto Rico	San German
	The Catholic University of Puerto Rico	Ponce
	University of Puerto Rico	Mayaguez
	University of Puerto Rico	Rio Pedras

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
RI	Brown University	Providence
	Providence College	Providence
	Roger Williams College	Bristol
	University of Rhode Island	Kingston
SC	Aiken Technical Education Center	Aiken
	Baptist College	Charleston
	Bob Jones University	Greenville
	Central Wesleyan College	Central
	Citadel Military College of South Carolina	Charleston
	Claflin College	Orangeburg
	Clemson University	Clemson
	Coastal Carolina College	Conway
	Coker College	Hartsville
	College of Charleston	Charleston
	Columbia College	Columbia
	Columbia Bible College	Columbia
	Converse College	Spartanburg
	Erskine College	Due West
	Florence-Darlington Technical College	Florence
	Francis Marion College	Florence
	Furman University	Greenville
	Greenville Technical College	Greenville
	Lander College	Greenwood
	Limestone College	Gaffney
	Morris College	Sumter
	Newberry College	Newberry
	North Greenville College	Tigerville
	Orangeburg-Calhoun Technical College	Orangeburg
	Piedmont Technical College	Greenwood
	South Carolina State College	Orangeburg
	Sumter Area Technical College	Sumter
	Tri County Technical College	Pendleton
	Trident Technical College	North Charleston
	University of South Carolina	Columbia
	University of South Carolina at Aiken	Aiken
	University of South Carolina at Beaufort	Beaufort
	University of South Carolina at Spartanburg	Spartanburg
	University of South Carolina at Union	Union
	Voorhees College	Denmark
	Winthrop College	Rock Hill
	Wofford College	Spartanburg
SD	Augustana College	Sioux Falls
	Black Hills State College	Spearfish
	Dakota Wesleyan University	Mitchell
	Freeman Junior College	Freeman
	National College of Business	Rapid City
	Northern State College	Aberdeen
	Presentation College	Aberdeen
	Sioux Falls College	Sioux Falls
	South Dakota School of Mines and Technology	Rapid City
	South Dakota State University	Brookings
	University of South Dakota-Springfield	Springfield
TN	Aquinas Junior College	Nashville
	Austin Peay State University	Clarksville
	Belmont College	Nashville
	Carson-Newman College	Jefferson City
	Chattanooga State Technical Community College	Chattanooga

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Christian Brothers College	Memphis
	Cleveland State Community College	Cleveland
	Columbia State Community College	Columbia
	Covenant College	Lookout Mountain
	Cumberland College	Lebanon
	David Lipscomb College	Nashville
	Dyersburg State Community College	Dyersburg
	East Tennessee State University	Johnson City
	Fisk University	Nashville
	Freed-Hardeman College	Henderson
	Free Will Baptist Bible College	Nashville
	George Peabody College for Teachers	Nashville
	Hiwassee College	Madisonville
	Jackson State Community College	Jackson
	King College	Bristol
	Knoxville College	Knoxville
	Lambuth College	Jackson
	LeMoyne-Owen College	Memphis
	Martin College	Pulaski
	Memphis State University	Memphis
	Middle Tennessee State University	Murfreesboro
	Milligan College	Milligan College
	Nashville State Technical Institute	Nashville
	Roane State Community College	Harriman
	Shelby State Community College	Memphis
	State Technical Institute at Memphis	Memphis
	Steed College	Johnson City
	Tennessee Technological University	Cookeville
	Tennessee Wesleyan College	Athens
	University of the South	Sewanee
	University of Tennessee	Knoxville
	University of Tennessee Center for Health Sciences	Memphis
	University of Tennessee at Martin	Martin
	University of Tennessee at Nashville	Nashville
	Vanderbilt University	Nashville
	Volunteer State Community College	Gallatin
	Walters State Community College	Morristown
TX	Abilene Christian University	Abilene
	Alvin Community College	Alvin
	Amarillo College	Amarillo
	American Technological University	Killeen
	Angelina College	Lufkin
	Angelo State University	San Angelo
	Austin College	Sherman
	Austin Presbyterian Technological Seminary	Austin
	Baylor College of Dentistry	Dallas
	Baylor College of Medicine	Houston
	Baylor University	Waco
	Bee County College	Beeville
	Blinn College	Brenham
	Brazosport College	Lake Jackson
	Cisco Junior College	Cisco
	Clarendon College	Clarendon
	College of the Mainland	Texas City
	Concordia Lutheran College	Austin
	Cooke County College	Gainesville
	Dallas Bible College	Dallas
	Dallas Christian College	Dallas
	Dallas County Community College District	
	Eastfield College	Mesquite
	El Centro College	Dallas
	Mountain View College	Dallas
	Richland College	Dallas

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Dallas Theological Seminary	Dallas
	Del Mar College	Corpus Christi
	DeVry Institute of Technology	Dallas
	East Texas Baptist College	Marshall
	East Texas State University	Commerce
	El Paso Community College	El Paso
	Frank Phillips College	Borger
	Galveston College	Galveston
	Grayson College	Denison
	Gulf Coast Bible College	Houston
	Hardin-Simmons University	Abilene
	Henderson County Junior College	Athens
	Houston Baptist University	Houston
	Houston Community College	Houston
	Howard College at Big Spring	Big Spring
	Howard Payne University	Brownwood
	Huston-Tillotson College	Austin
	Incarnate Word College	San Antonio
	Jacksonville College	Jacksonville
	Jarvis Christian College	Hawkins
	Kilgore College	Kilgore
	Lamar University	Beaumont
	Laredo Junior College	Laredo
	Lee College	Baytown
	Le Tourneau College	Longview
	Lon Morris College	Jacksonville
	Lubbock Christian College	Lubbock
	McLennan Community College	Waco
	McMurry College	Abilene
	Midland College	Midland
	Midwestern State University	Wichita Falls
	Navarro College	Corsicana
	North Harris County College	Houston
	North Texas State University	Denton
	Odessa College	Odessa
	Our Lady of the Lake University of San Antonio	San Antonio
	Pan American University	Edinburg
	Panola Junior College	Carthage
	Ranger Junior College	Ranger
	Rice University	Houston
	Saint Edward's University	Austin
	Sam Houston State University	Huntsville
	San Antonio College	San Antonio
	San Jacinto College	Pasadena
	Schreiner College	Kerrville
	Southern Bible College	Houston
	Southern Methodist University	Dallas
	South Plains College	Levelland
	South Texas College of Law	Houston
	Southwestern Assemblies of God College	Waxahachie
	Southwestern Baptist Theological Seminary	Fort Worth
	Southwestern Christian College	Terrell
	Southwestern Union College	Keene
	Southwestern University	Georgetown
	Southwest Texas State University	San Marcos
	Stephen F. Austin State University	Nacogdoches
	Tarleton State University	Stephenville
	Tarrant County Junior College-Northeast Campus	Hurst
	Tarrant County Junior College-Northwest Campus	Fort Worth
	Tarrant County Junior College-South Campus	Fort Worth
	Texarkana College	Texarkana
	Texas A & I University	Kingsville

APPENDIX V

CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Texas A & I University-Corpus Christi	Corpus Christi
	Texas A & I University-Laredo	Laredo
	Texas A & M University-Main Campus	College Station
	Texas A & M University Moody College of Marine Sciences and Maritime Resources	Galveston
	Texas Christian University	Fort Worth
	Texas College	Tyler
	Texas Lutheran College	Seguin
	Texas Southmost College	Brownsville
	Texas State Technical Institute-James Connally Campus	Waco
	Texas State Technical Institute-Mid-Continent Campus	Amarillo
	Texas State Technical Institute-Rio Grande Campus	Harlingen
	Texas Tech University	Lubbock
	Texas Wesleyan College	Fort Worth
	Texas Woman's University	Denton
	Trinity University	San Antonio
	Tyler Junior College	Tyler
	University of Dallas	Irving
	University of Houston-Main Campus	Houston
	University of Houston-Clear Lake City	Houston
	University of Houston-Victoria Campus	Victoria
	University of Texas-Arlington	Arlington
	University of Texas-Austin	Austin
	University of Texas at Dallas	Richardson
	University of Texas-El Paso	El Paso
	University of Texas Health Science Center at Dallas	Dallas
	University of Texas Health Science Center at Houston	Houston
	University of Texas Medical Branch at Galveston	Galveston
	University of Texas-San Antonio	San Antonio
	Vernon Regional Junior College	Vernon
	Victoria College	Victoria
	Weatherford College	Weatherford
	Western Texas College	Snyder
	West Texas State Universtiy	Canyon
	Wharton County Junior College	Wharton
	Wiley College	Marshall
UT	Brigham Young University	Provo
	Stevens Henager College	Ogden
	University of Utah	Salt Lake City
	Utah Higher Education System Office	
	University of Utah	Salt Lake City
	Utah State University	Logan
	Southern Utah State College	Cedar City
	Weber State College	Ogden
	College of Eastern Utah	Price
	Dixie College	Saint George
	Snow College	Ephraim
	Utah Technical College at Salt Lake City	Salt Lake City
	Westminster College	Salt Lake City

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
VT	Champlain College	Burlington
	Johnson State College	Johnson
	Lyndon State College	Lyndonville
	Marlboro College	Marlboro
	Middlebury College	Middlebury
	Norwich University	Northfield
	Saint Michael's College	Winooski
	School for International Training	Brattleboro
	Southern Vermont College	Bennington
	Trinity College	Burlington
	University of Vermont and State Agriculture College	Burlington
	Vermont Institute of Community Involvement	South Burlington
	Vermont Technical College	Randolph Center
	Windham College	Putney
VA	Averett College	Danville
	Bridgewater College	Bridgewater
	College of William and Mary	Williamsburg
	Eastern Mennonite College	Harrisonburg
	Eastern Virginia Medical School	Norfolk
	Emory and Henry College	Emory
	Ferrum College	Ferrum
	Hampton Institute	Hampton
	Institute of Textile Technology	Charlottesville
	J. Sargeant Reynolds Community College	Richmond
	Madison University	Harrisonburg
	Old Dominion University	Norfolk
	Radford College	Radford
	Randolph-Macon College	Ashland
	Randolph-Macon Woman's College	Lynchburg
	Saint Paul's College	Lawrenceville
	University of Virginia	Charlottesville
	Virginia Intermont College	Bristol
	Virginia Military Institute	Lexington
	Virginia Polytechnic Institute and State University	Blacksburg
	Virginia Wesleyan College	Norfolk
	Washington and Lee University	Lexington
	Wytheville Community College	Wytheville
WA	Bellevue Community College	Bellevue
	Big Bend Community College	Moses Lake
	Centralia College	Centralia
	Central Washington State College	Ellensburg
	Clark College	Vancouver
	Columbia Basin Community College	Pasco
	Cornish School of Allied Arts	Seattle
	Eastern Washington State College	Cheney
	Evergreen State College	Olympia
	Fort Steilacoom Community College	Tacoma
	Fort Wright College of the Holy Names	Spokane
	Gonzaga University	Spokane
	Grays Harbor College	Aberdeen
	Green River Community College	Auburn
	Highline Community College	Midway
	Lower Columbia College	Longview
	Lutheran Bible Institute of Seattle	Seattle
	Northwest College of the Assemblies of God	Kirkland
	Olympia Technical Community College	Olympia
	Olympic College	Bremerton
	Pacific Lutheran University	Tacoma
	Peninsula College	Port Angeles

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Seattle Community College District	
	North Seattle Community College	Seattle
	Seattle Community College-Central Campus	Seattle
	Seattle Community College-South Campus	Seattle
	Seattle University	Seattle
	Shoreline Community College	Seattle
	Skagit Valley College	Mount Vernon
	Tacoma Community College	Tacoma
	University of Puget Sound	Tacoma
	Walla Walla College	College Place
	Walla Walla Community College	Walla Walla
	Washington State Community College-District 5	
	Edmonds Community College	Lynnwood
	Everett Community College	Everett
	Washington State Community College-District 17	
	Spokane Falls Community College	Spokane
	Washington State University	Pullman
	Wenatchee Valley College	Wenatchee
	Western Washington State College	Bellingham
	Whatcom Community College	Bellingham
	Whitman College	Walla Walla
	Whitworth College	Spokane
	Yakima Valley College	Yakima
WV	Alderson Broaddus College	Phillippi
	Beckley College	Beckley
	Bethany College	Bethany
	Bluefield State College	Bluefield
	Concord College	Athens
	Davis and Elkins College	Elkins
	Glenville State College	Glenville
	Marshall University	Huntington
	Morris Harvey College	Charleston
	Parkersburg Community College	Parkersburg
	Potomac State College	Keyser
	Salem College	Salem
	West Liberty State College	West Liberty
	West Virginia Institute of Technology	Montgomery
	West Virginia University	Morgantown
	Wheeling College	Wheeling
WI	Alverno College	Milwaukee
	Beloit College	Beloit
	Blackhawk Technical Institute	Janesville
	Cardinal Stritch College	Milwaukee
	Carroll College	Waukesha
	Carthage College	Kenosha
	Concordia College	Milwaukee
	District One Technical Institute	Eau Claire
	Edgewood College	Madison
	Fox Valley Technical Institute	Appleton
	Gateway Technical Institute	Kenosha
	Holy Redeemer College	Waterford
	Institute of Paper Chemistry	Appleton
	Lakeshore Technical Institute	Cleveland
	Lawrence University	Appleton
	Madison Area Technical College	Madison
	Madison Business College	Madison
	Marian College of Fond Du Lac	Fond Du Lac
	Marquette University	Milwaukee
	Mid-State Technical Institute	Wisconsin Rapids
	Milton College	Milton

APPENDIX V
CATALOGS REVIEWED

STATE	INSTITUTION	LOCATION
	Milwaukee Area Technical College	Milwaukee
	Moraine Park Vocational, Technical and Adult Education Institute	Fond Du Lac
	Mount Mary College	Milwaukee
	Mount Senario College	Ladysmith
	Nicolet College and Technical Institute	Rhinelander
	North Central Technical Institute	Wausau
	Northeast Wisconsin Technical Institute	Green Bay
	Northland College	Ashland
	Ripon College	Ripon
	Saint Norbert College	De Pere
	Silver Lake College	Manitowoc
	Southwest Wisconsin Vocational-Technical Institute	Fennimore
	University of Wisconsin-Green Bay	Green Bay
	University of Wisconsin-Madison	Madison
	University of Wisconsin-Milwaukee	Milwaukee
	University of Wisconsin-System Office	Madison
	Viterbo College	La Crosse
	Waukesha County Technical Institute	Pewaukee
	Western Wisconsin Technical Institute	La Crosse
WY	Casper College	Casper
	Eastern Wyoming College	Torrington
	Laramie County Community College	Cheyenne
	Northwest Community College	Powell
	Sheridan College	Sheridan
	University of Wyoming	Laramie
	Western Wyoming Community College	Rock Springs